

AUGUST, 1957

**RUBBER
WORLD**

NOW IN ITS 68th YEAR

**ESS R. Ormsby, RMA
President, Who Will
Discuss Association
Activities Before
Rubber Division
New York Meeting
September**

Blackstone Studios

BILL BROTHERS
PUBLICATION

ANNOUNCING

ZALBA®

- an outstanding non-staining and non-discoloring antioxidant for general use. Especially effective in neoprene and natural rubber latices. Aqueous dispersions are easy to make and use.
- effective, too, in dry neoprene and rubber compounds.
- excellent protection against oxidation and heat.
- excellent resistance to gas discoloration.
- efficient and economical. Lower cost than other good non-staining antioxidants of hindered phenol type, such as SOLUX NS.
- a protective stabilizer for butadiene-styrene copolymers.
- prevents gel formation in SBR rubbers and improves processing.

E. I. du Pont de Nemours & Co. (Inc.)
Elastomer Chemicals Department
Wilmington 98, Delaware

DISTRICT OFFICES:

Akron 8, Ohio, 40 E. Buchtel Ave.	Portage 2-8461
Atlanta, Ga., 1261 Spring St., N.W.	Trinity 5-5391
Boston 10, Mass., 140 Federal St.	Hancock 6-1711
Charlotte 2, N. C., 427 West Fourth St.	Franklin 5-556
Chicago 3, Ill., 7 South Dearborn St.	ANDover 3-7000
Detroit 35, Mich., 13000 West 7-Mile Rd.	UNiversity 4-1963
Houston 25, Texas, 1100 E. Holcombe Blvd.	JACKson 9-2666
Los Angeles 58, Calif., 2930 E. 44th St.	LUdlow 2-6464
Trenton 8, N. J., 1750 North Olden Ave.	EXport 3-7141

In Canada contact DuPont Company of Canada (1956) Limited, Box 660, Montreal

Du Pont
RUBBER CHEMICALS



BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

Publisher
B. BRITAIN WILSON

Editor
ROBERT G. SEAMAN

Managing Editor
S. R. HAGUE

Associate Editor
MORTON ZELENKO

Assistant Editor
CHARLES C. ORR

Foreign Editor
L. THAKAR

Production Manager
M. A. LARSON

Circulation Manager
M. J. MCCARTHY

Editorial
Advisory Board
JOHN BALL
P. D. BRASS
B. H. CAPEN
C. C. DAVIS
WALTER S. EDSALL
J. H. FIELDING
S. D. GEHMAN
LOUIS H. HOWLAND
J. H. INGMANSON
EDWIN B. NEWTON

BUSINESS STAFF

PAUL T. BAUMHART
Eastern Sales Manager
ROBERT L. MILLER
Eastern Sales Representative
386 Fourth Avenue,
New York 16, New York
LExington 2-1760

WILLIAM T. BISSON
Midwest Sales Manager
163 West Exchange Street
Akron 2, Ohio
FRanklin 6-3434

MARIE BERUBE
Representative
333 North Michigan Avenue
Chicago 1, Illinois
STate 2-1266

ROBERT E. AHRENSDORF
Representative
5720 Wilshire Boulevard
Los Angeles 36, California
WEbster 8-3881

RUBBER WORLD

AUGUST, 1957

VOLUME 136, NUMBER 5

FEATURES

DOES AMERICA SPEND ENOUGH ON RESEARCH?

R. G. Seaman 673

An editorial.

NON-FREE SULFUR CURING SYSTEMS FOR AGE RESISTANT STYRENE-BUTADIENE RUBBER

L. M. Hobbs, R. G. Craig, C. W. Burkhart 675

The resistance to air-oven aging of SBR vulcanizates has been found to be best when they are cured with a combination of conventional ultra-accelerators and dicumyl peroxide. The cost of these superior aging compounds is only slightly greater than that of free sulfur-accelerator systems.

WADC EVALUATION OF EXPERIMENTAL POLYMERS

W. R. Griffin 687

Air Force requirements for elastomers capable of -100 to +600° F. service in a variety of fluids are closely approached by certain new polymers, mostly fluorine containing. Additional new polymers with an even broader range of service properties, however, are still required.

A VERSATILE NEW FAMILY OF ELASTOMERS—II

G. E. Meyer, W. E. Gibbs, F. J. Naples, R. M. Pierson, W. M. Saltman, R. W. Schrock, L. B. Tewksbury, G. S. Trick 695

Low-temperature, solvent swelling, ozone resistance, and radiation resistance properties of these mercaptan-diene adduct polymers are described in this second and concluding installment.

RUBBER DIVISION, ACS, PROGRAM FOR FALL MEETING 702

Goodyear Medal Award, invited paper by RMA President Ormsby, and 25 technical papers on carbon black and polymers, compounding, testing, and new polymers comprise the program for this meeting in New York in mid-September.

DEPARTMENTS

Meetings and Reports	702	New Products	742
News of the Month		Book Reviews	742
United States	708	New Publications	744
Obituaries	730	Market Reviews	746
Financial	730	Calendar of Coming Events	748
News from Abroad	731	Statistics	750
New Equipment	734	Advertisers Index	763
New Materials	738		

Cover Photo: Courtesy of The Rubber Manufacturers Association, Inc.

Published monthly by

BILL BROTHERS PUBLISHING CORPORATION



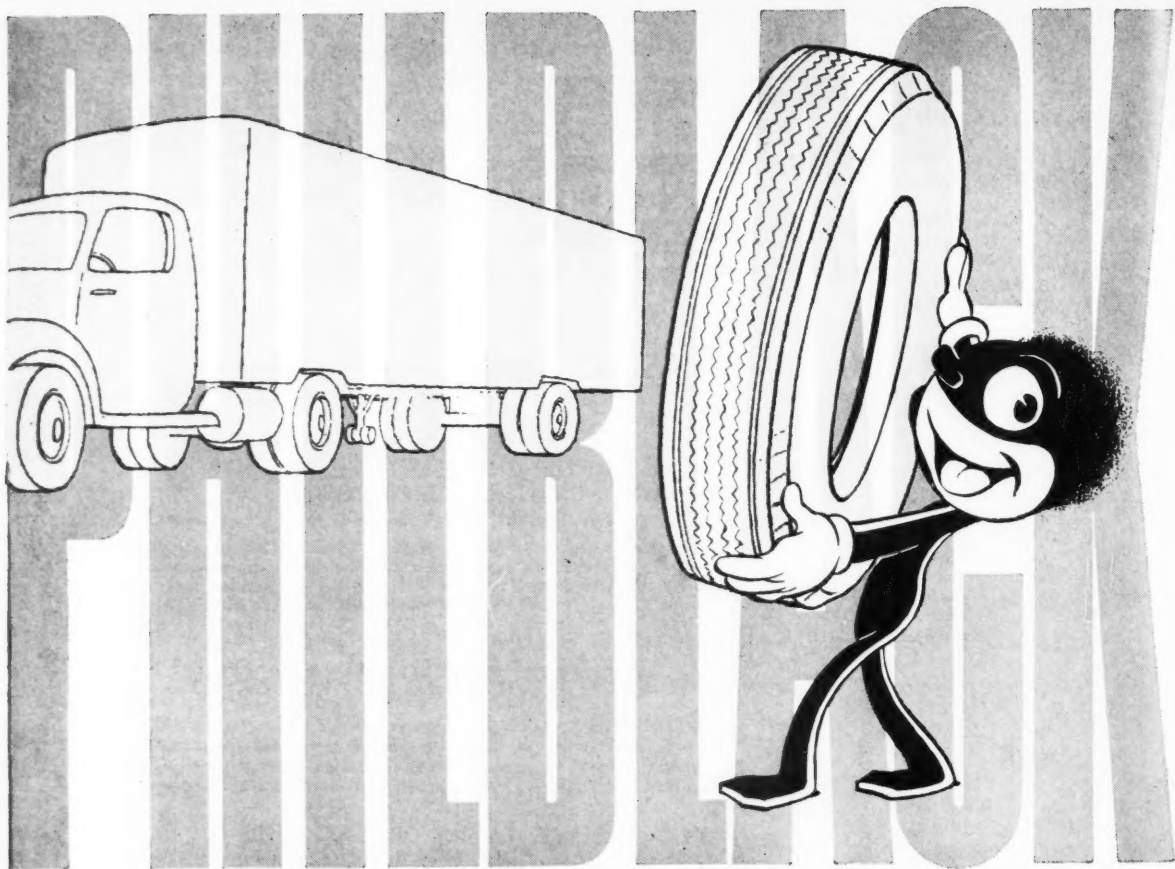
386 Fourth Avenue, New York 16, N. Y.

The opinions expressed by our contributors do not necessarily reflect those of our editors.



Chairman of the Board, Philip Salisbury. President, John W. Hartman. Treasurer, Ralph L. Wilson. Vice Presidents, B. Brittain Wilson, C. Ernest Lovejoy, Wm. H. McCleary. Editorial and Executive Offices, 386 Fourth Ave., New York 16, N. Y. LExington 2-1760. Subscription Price: United States and Possessions, \$5.00. Canada, \$6.00 per year. All other countries, \$7.00. Single

copies in the U. S., 50¢; elsewhere, 60¢. Other Bill Brothers Publications: In Industry: Plastics Technology. In Marketing: Sales Management, Sales Meetings, Tide, Premium Practice. In Merchandising: Floor Covering Profits, Fast Food, Grocer-Graphic, Tires-TBA Merchandising, Yankee Grocer. Members of Business Publications Audit of Circulation, Inc.



Use Philblack E^{*}

for the toughest, hardest jobs

Philblack E is tops for toughness, unsurpassed for abrasion resistance, gives excellent crack resistance, too. Use it in truck tires or in any product that must withstand severe wear.

And there are other Philblacks to meet any specific need of your particular rubber products. Consult your Phillips Technical Representative for full information.

LET ALL THE PHILBLACKS WORK FOR YOU!

- A** Philblack A, Fast Extrusion Furnace Black. Excellent tubing, molding, calendaring, finish! Mixes easily. Disperses heat. Non-staining.
- O** Philblack O, High Abrasion Furnace Black. For long, durable life. Good conductivity. Excellent flex life and hot tensile. Easy processing.
- I** Philblack I, Intermediate Super Abrasion Furnace Black. Superior abrasion. More tread miles at moderate cost.
- E** Philblack E, Super Abrasion Furnace Black. Toughest black yet! Extreme resistance to abrasion.



PHILLIPS CHEMICAL COMPANY, Rubber Chemicals Division, 318 Water St., Akron 8, Ohio. District Offices: Chicago, Providence and Trenton. West Coast: Harwick Standard Chemical Company, Los Angeles, California. Warehouse stocks at above points and Toronto, Canada. Export Sales: 80 Broadway, New York 5, N. Y.

^{*}A trademark

News about

B.F. Goodrich Chemical *raw materials*

PROTECT
AGAINST
SCORCHING

IMPROVE
RUBBER
PROCESSING

with
Good-rite
REG. U. S. PAT. OFF.
VULTROL!

RUBBER compounders find many processing advantages with Good-rite Vultrol. It prevents scorching the year 'round . . . retards scorch at processing temperatures and also acts as a mild activator at curing temperatures.

MORE ADVANTAGES—Good-rite Vultrol is beneficial on highly-loaded or highly-accelerated

compounds. It is particularly effective with high abrasion furnace blacks. Vultrol permits uninterrupted production, reduces "dead" stocks, requires no special handling.

Supplied as a free-flowing flake, Good-rite Vultrol is economical and easy to use—saves time, money and labor. For informa-

tion, please write Dept. HN-8, B.F. Goodrich Chemical Company, 3135 Euclid Ave., Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

Good-rite
GOOD-RITE
CHEMICALS

B.F. Goodrich Chemical Company
a division of The B.F. Goodrich Company

B.F. Goodrich

GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

August, 1957

Goodrich-Gulf Chemicals, Inc.

Ameripol...

OIL-EXTENDED POLYMERS

Types	Physical Properties*
1703	Tensile 3240 psi.
	Elongation 650 %
	Modulus @ 300% Elongation 990 psi.
	Mooney Viscosity—
	ML212°F. @ 4 minutes
1705	Raw Polymer 59
	Compounded Stock 56
	Tensile 3800 psi.
	Elongation 690 %
	Modulus @ 300% Elongation 860 psi.
1707	Mooney Viscosity—
	ML212°F. @ 4 minutes
	Raw Polymer 60
	Compounded Stock 57
	Tensile 3170 psi.
1708	Elongation 760 %
	Modulus @ 300% Elongation 630 psi.
	Mooney Viscosity—
	ML212°F. @ 4 minutes
	Raw Polymer 55
1710	Compounded Stock 48
	Tensile 3280 psi.
	Elongation 610 %
	Modulus @ 300% Elongation 950 psi.
	Mooney Viscosity—
1712	ML212°F. @ 4 minutes
	Raw Polymer 61
	Compounded Stock 55
	Tensile 3310 psi.
	Elongation 720 %
	Modulus @ 300% Elongation 670 psi.
	Mooney Viscosity—
	ML212°F. @ 4 minutes
	Raw Polymer 55
	Compounded Stock 51
	Tensile 3180 psi.
	Elongation 730 %
	Modulus @ 300% Elongation 690 psi.
	Mooney Viscosity—
	ML212°F. @ 4 minutes
	Raw Polymer 55
	Compounded Stock 51

*Typical average production values. Cure 50' @ 292°F.

Selection Guide

An improved, lighter colored rubber, relatively non-discoloring and non-staining. Used for white and pastel colored mechanical goods, floor tile, toys, sheeting, etc.

General purpose pastel rubber used where color is not important . . . in tires, molded and extruded products.

A non-staining polymer. Used for extrusions, molded products, shoe soles and heels, etc.

Non-staining polymer with relatively low water absorption, improved electrical properties. Used for electrical insulation, athletic goods, coated fabrics, moldings and extrusions.

Similar to 1705, with higher oil content. Used for tires, molded and extruded products.

Used for insulation, tires, molded and extruded goods.

Oil-extended man-made rubber provides balance of properties and economy

Ameripol is the preferred butadiene-styrene rubber—superior or equal to natural rubber in aging, resistance to wear, weathering, water, oil, permeability to gases.

The cold oil-extended Ameripol grades cost about 20 to 25% less than other grades, yet offer many of the same desirable physical properties. The addition of oil to latex of this type results in an easier processing polymer at lower cost.



Write for free copy

of 24-page booklet "Ameripol—the preferred rubber". Complete technical data helps you select and specify.



Goodrich-Gulf Chemicals, Inc.

3121 Euclid Avenue • Cleveland 15, Ohio

Naugatuck RETARDER-J

**New, IMPROVED ANTI-SCORCH
ASSURES PROCESSING SAFETY
for natural and synthetic treads**



The scorch problem created by SAF, ISAF and HAF blacks in natural rubber treads can be overcome with sulfenamides with *greater processing safety* when Naugatuck's improved Retarder-J is used. At vulcanizing temperatures, Retarder-J has less retarding effect on the rate of cure than any other commercial anti-scorch material... is, in fact, mildly activating in some cases.

Effective also in sponge, C.V. insulated wire, mechanical goods, and other rubber items, Retarder-J functions well in *all* types of rubber compounds.

In GR-S tread compounds, with sulfenamide-type accelerators, it gives maximum processing safety with fast, high-temperature cures. In Nitrile (Paracril®) type mechanical goods compounds, it activates mildly at curing temperature, and provides scorch safety.

In sponge compounds, it delays curing until the blowing action has been completed.

For data on Mooney scorch and physical properties of various rubber compounds, with and without Retarder-J, write for Bulletin 209.



Naugatuck Chemical

**Division of United States Rubber Company
Naugatuck, Connecticut**

IN CANADA: NAUGATUCK CHEMICALS DIVISION
Dominion Rubber Company, Limited, Elmira, Ontario • Rubber Chemicals • Synthetic
Rubber • Plastics • Agricultural Chemicals • Reclaimed Rubber • Latexes • Cable Address: Rubexport, N.Y.



FRENCH

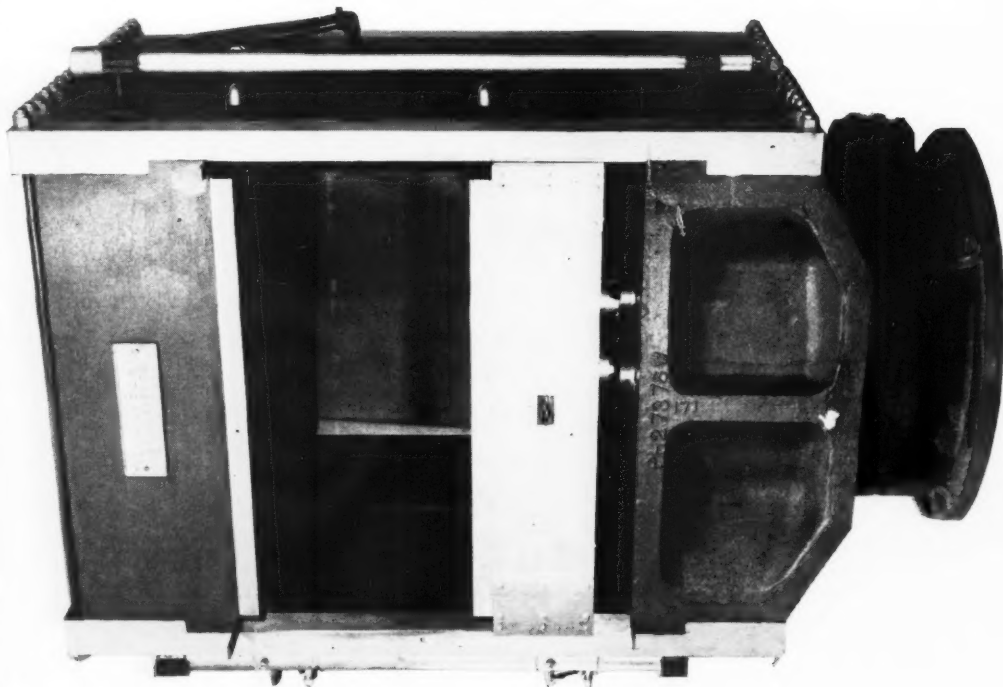
SIDE-PLATE MOLDING PRESSES

Incorporating economy of standard construction, the photograph is another demonstration of design flexibility. Patented features assure the owner of a French press, the most rigid, accurate, trouble-free press available. You'll be surprised at the reasonable price.

Improve close tolerance molding
Virtually eliminate press maintenance
Reduce scrap loss

WRITE FOR ILLUSTRATED CATALOG

THE FRENCH OIL MILL MACHINERY CO.
(HYDRAULIC PRESS DIVISION)
1011 GREENE ST.,
PIQUA, OHIO



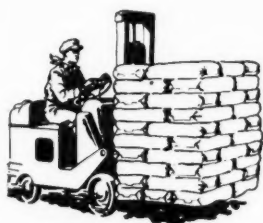
1250-ton hot-plate press
30" stroke
60" x 60" pressing surface

CUT COSTS **BOTH** WAYS

with

PROTOX-166[®]

ZINC OXIDE

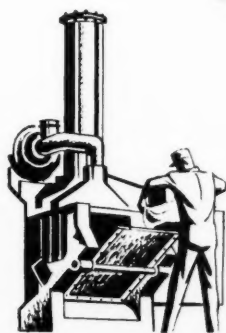


1. Cut Handling and Storage Costs

Protox*-166 is dense. It bulks only about half that of conventional zinc oxides.

Thus you can handle Protox-166 faster and store it in a smaller space.

2. Cut Processing Costs



Protox-166 is outstanding for dispersion. It disperses readily in any rubber under any weather conditions . . . because it is free of aggregates and its particles are coated with zinc propionate that is readily wet by rubber.

Protox-166 is outstanding for calendering and extruding. It provides smoother calendering with less shrinkage, smoother extruding with less die swell, and longer runs on strainers.

Thus you can cut processing time and step up output with Protox-166.

U. S. Patents 2,303,329 and 2,303,330

THE NEW JERSEY ZINC COMPANY

Founded 1848

160 Front Street, New York 38, N. Y.

BOSTON CHICAGO CLEVELAND OAKLAND LOS ANGELES

Also Distributed by

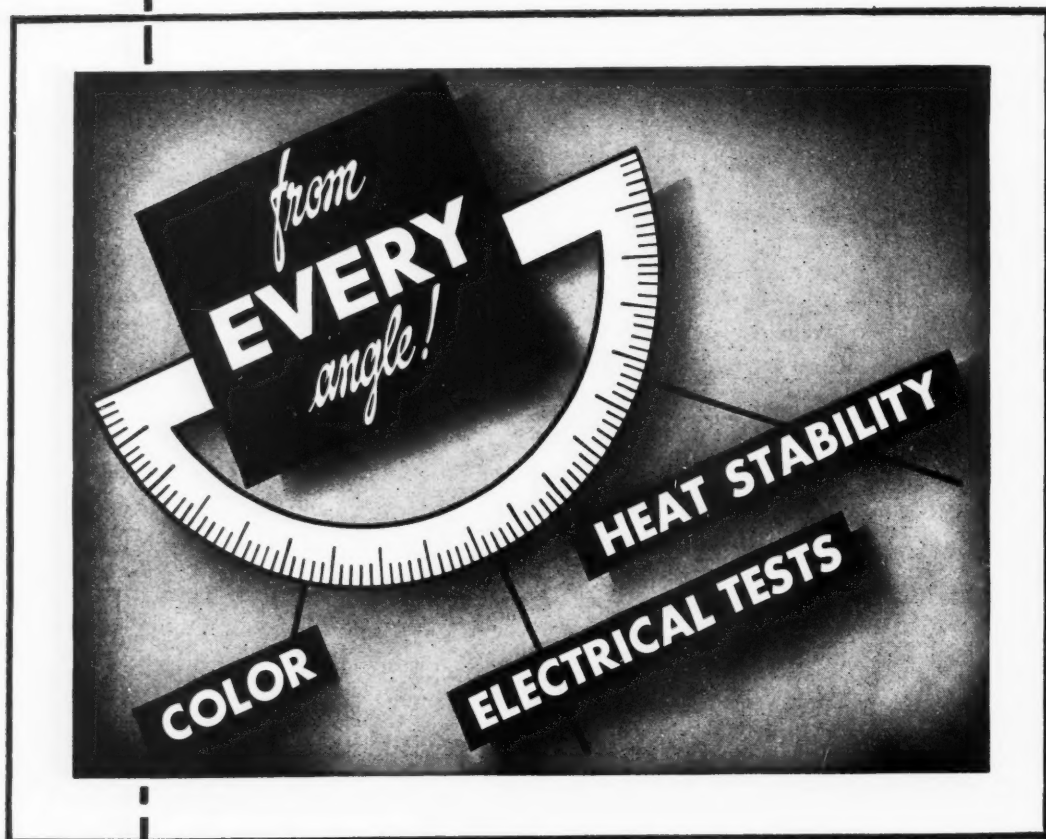
VAN WATERS AND ROGERS

SEATTLE PORTLAND (ORE.) SPOKANE VANCOUVER, B. C. DALLAS HOUSTON

ST. LAWRENCE CHEMICAL COMPANY, LTD.

TORONTO, ONT. MONTREAL, QUE.





PIGMENT NO. 33

for Compounding

VINYLS AND
SYNTHETIC RUBBER

Sample and technical data
sent promptly on request

SOUTHERN CLAYS, Inc.

33 RECTOR STREET
NEW YORK 6, N. Y.



Photo courtesy Union Tank Car Company, Chicago, Illinois. Insulation hardboard supplied by Rubatex Division, Great American Industries, Inc., Bedford, Virginia

It cuts chilling costs to the bone

It's a cold fact: Proper insulation is the key to low-cost storage and transportation at low temperatures. Being applied above to liquid carbon dioxide cars is a lightweight hardboard made of expanded PLIOFLEX rubber which does a matchless job of efficiently and economically shutting cold, heat and moisture—in or out.

Millions of tiny, closed cells—filled with nitrogen and bound by tough hard rubber—give this board the lowest conductivity of any known structural material. It also is strong enough to be used in self-supporting construction, does not require a vapor barrier and can be easily cut to shape and installed.

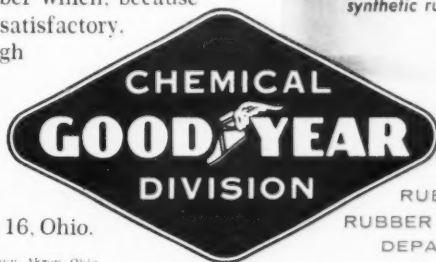
When first introduced, this product was made from natural rubber. But wartime shortages caused a change to synthetic rubber which, because of its uniformity, soon proved to be much more satisfactory. PLIOFLEX is used today because of its unusually high uniformity and consistently low moisture content.

Just one of many uses for versatile PLIOFLEX is chemically blown insulation. How can you use this high-quality, "hot," "cold" or oil-extended rubber to advantage? Find out by writing for details to: Goodyear, Chemical Division, Dept. H-9418, Akron 16, Ohio.

Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latexes and Related Chemicals for the Process Industries



RUBBER &
RUBBER CHEMICALS
DEPARTMENT

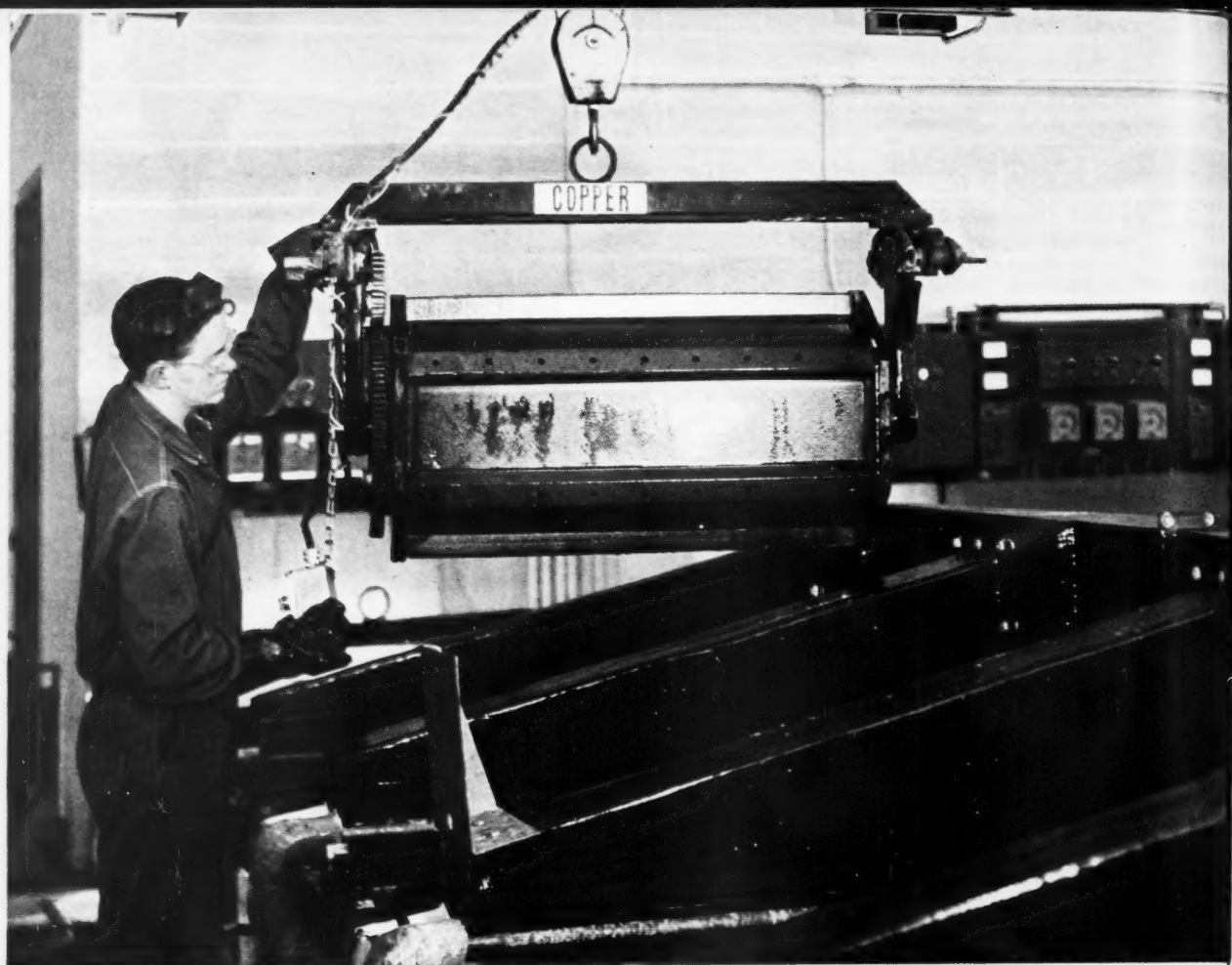


Photo courtesy American Hard Rubber Company, New York, N. Y. and Udylite Corporation, Detroit, Michigan

New Answer to a Barrel of Hot Problems

Hot problem for a leading supplier of electroplating barrels was finding the right material for the cylinders. In the face of repeated exposure to heat, hard wear and corrosive plating solutions, these cylinders had to keep rolling without contaminating the baths. After many tries, they found the answer—a new, clean-running hard rubber with three times longer life.

The major advance of this new material over its predecessors springs from the fact that it's made with CHEMIGUM nitrile rubber. Its manufacturer uses CHEMIGUM for a combination of strength plus resistance to high temperatures, chemicals and solvents never before achieved in hard rubber.

Besides better barrels for plating, CHEMIGUM as hard rubber has wide applications as pipe fittings and other equipment for handling chemicals at high temperatures. In other forms, CHEMIGUM finds use in many other products requiring unusual resistance to oils, solvents and chemicals over a wide range of temperatures.

If you have a need for an unusually versatile oil-resistant rubber of high quality, be sure you have the full story on CHEMIGUM. It's easy to get. Just write to: Goodyear, Chemical Division, Dept. H-9418, Akron 16, Ohio.

Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic—T. M.'s The Goodyear Tire & Rubber Company, Akron, Ohio



**RUBBER &
RUBBER CHEMICALS
DEPARTMENT**

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS

High Polymer Resins, Rubbers, Latexes and Related Chemicals for the Process Industries

"Hot" PLIOFLEX Rubber
Protected with WING-STAY S

"Cold" PLIOFLEX Rubber
Protected with WING-STAY S

"Hot" Styrene Rubber
Protected with Antioxidant "A"

"Cold" Styrene Rubber
Protected with Antioxidant "A"

NOTE: All samples exposed to direct sunlight for three weeks

How to stop the sun in its attack on rubber



Rubber &
Rubber Chemicals
Department

Exposure to sunlight can result in premature surface hardening and cracking of both natural and synthetic rubber goods. But *not* if you use WING-STAY S—the outstanding, nonstaining, non-discoloring antioxidant on today's market.

WING-STAY S is a liquid styrenated phenol. Easily incorporated into dry rubber or latices, it is extremely resistant to heat, sunlight or extraction by water—provides economical protection against aging with a minimum of discoloration, odor or migration.

Compare the test pieces pictured above. They show how much more protection WING-STAY S gives styrene rubber against direct sunlight than does another well-known nonstaining antioxidant. Your own tests will give you further proof of its superiority. So write, today, for samples and the latest *Tech Book Bulletins*. The address:

Goodyear, Chemical Division,
Akron 16, Ohio.

Chemigum, Plioflex, Pliolite, Plio-Tuf, Pliovic, Wing-Stay-T.M.'s The Goodyear Tire & Rubber Company, Akron, Ohio

CHEMIGUM • PLIOFLEX • PLIOLITE • PLIO-TUF • PLIOVIC • WING-CHEMICALS
High Polymer Resins, Rubbers, Latices and Related Chemicals for the Process Industries



laboratory evaluation of new formulations

ALCO VULCANOL® +

ALCO TECHNICAL SERVICE = BETTER PRODUCTS

VULCANOLS, latex-based formulations, are tailored by Alco laboratories to fit your particular requirements. Our laboratories specialize in this type of service.

VULCANOLS can be applied to your product by roller, puddle, spray or dip methods.

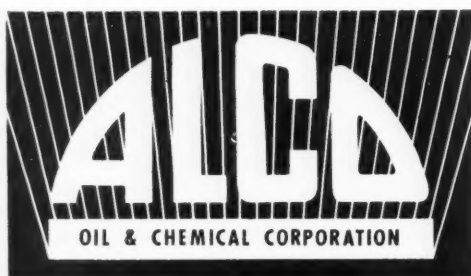
They can be used either as coatings or as adhesives. Coating textiles with Vulcanols provides dimensional stability, pile anchorage, slippage resistance, non-skid and non-fray properties and desired hand.

Adhesive uses include laminating paper for tapes and bagging, fabrics for shoes, and scrap foam or curled hair for cushioning.

Have you tried VULCAFOAM® for providing a foam backing for your fabrics?

Our sales and technical staffs will gladly assist you.

Distributor
for
Firestone
Liberian
Latex



GENERAL OFFICE and MANUFACTURING PLANTS
TRENTON AVENUE and WILLIAM STREET,
PHILADELPHIA 34, PA. GARFIELD 5-0621

ASK YOUR VELSICOL REPRESENTATIVE . . .

How these men can become your best reclaimed rubber salesmen



Velsicol chemists, working with information furnished by your Velsicol representative, can develop custom reclaiming oils that will make your reclaimed rubber easier to process and easier to combine with natural and synthetic rubber. By supplying an oil that meets your exact requirements, they can increase your sales to new and existing markets, and greatly improve your competitive position. Contact your Velsicol representative now, and put Velsicol research to work in your reclaiming processes. No cost or obligation. Mail the coupon today for new technical literature!



VELSICOL CHEMICAL CORPORATION

330 EAST GRAND AVENUE, CHICAGO 11, ILLINOIS



**LOOK
FOR
THIS
MAN**

Your Velsicol representative . . . a qualified chemist who will help you make better products for less!

VELSICOL

VELSICOL CHEMICAL CORPORATION
330 East Grand Avenue, Chicago 11, Illinois

- ☐ Please have a salesman call to discuss custom made reclaiming oils.
- ☐ Please send a sample for pilot plant use.
- ☐ Please send technical literature.

NAME _____
COMPANY _____
ADDRESS _____
CITY _____ ZONE _____ STATE _____

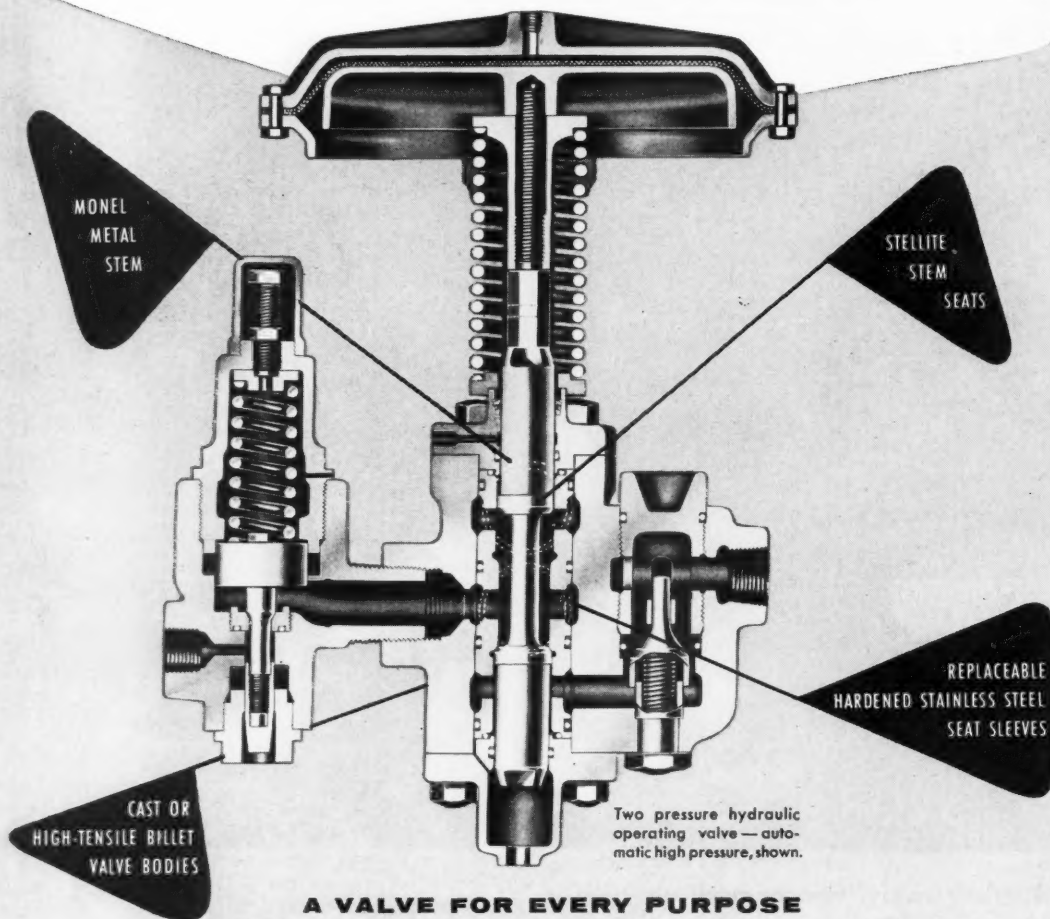
August, 1957

633

when choosing diaphragm-operated
control valves . . .

GET THE INSIDE STORY

...You'll specify **Sinclair-Collins!**



A VALVE FOR EVERY PURPOSE

- 2, 3 and 4-way • single or two pressure • high or low pressure—air operated
- for oil, air, steam, hot or cold water service • remote manual or automated control

To assure peak performance, longest trouble-free service and minimum operating costs, get all the facts before you select diaphragm-operated control valves for new machines or in-plant replacements.

Proper type, size and capacity are only part of the valve story . . . design features, component materials and precision manufacturing make the real difference!

If the valve you're considering does not have a Monel stem with electro-bonded Stellite seats,

replaceable hardened stainless steel seat sleeves, cast navy bronze or hi-tensile alloy billet body and easy-to-service construction with completely interchangeable parts, it's *not* a Sinclair-Collins! Can you afford to choose any valve that does not have all these performance and economy features?

Your nearby Sinclair-Collins representative can meet your valve needs *exactly* . . . in sizes from ½ to 3 in. . . with prompt delivery from stock. Call him today!

AA-6412

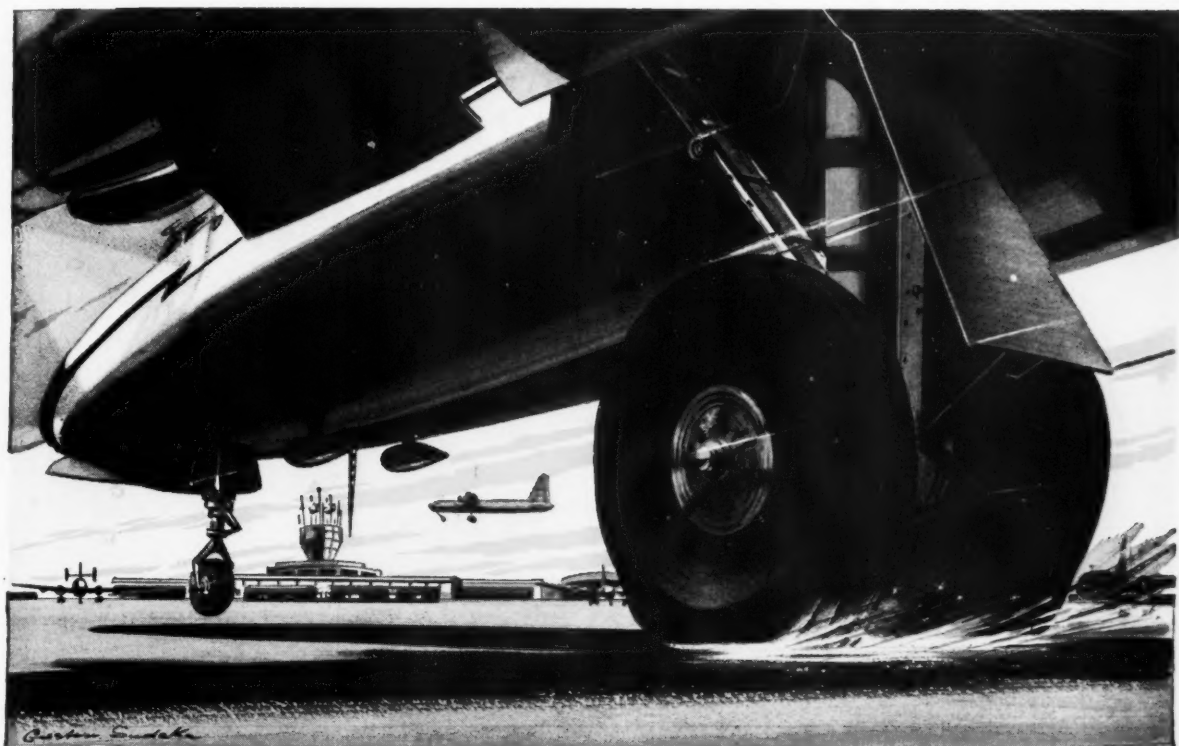
Write for brochure!

Representatives in principal cities

THE SINCLAIR-COLLINS VALVE COMPANY

454 Morgan Avenue Akron 11, Ohio

Naugatuck PYRATEx



**gives
super
adhesion
to carcass
cords!**

Planes, off-the-road trucks and earth-moving equipment put terrific strains on tire carcasses . . . strains that demand *super adhesion* in the rubber that bonds the carcass cords. And that's the kind of adhesion PYRATEx* gives to rayon, nylon or cotton cords!

This vinyl pyridine copolymer latex, compounded with resorcinol-formaldehyde, can be used full strength as a cord or fabric dip to produce *maximum* rubber-to-fiber adhesion. For lower-cost formulations the Pyratex-resorcinol-formaldehyde compound may be added to a butadiene-styrene latex in the proportion of 25 to 75 on the basis of solids content. For use as a cord dip the solution is further diluted to a solids concentration of between 10% and 20%.

Even this economical blend of PYRATEx gives RS-type latex almost *two-thirds more adhesion* to rayon and nylon fibers . . . greatly improves fatigue resistance.

Take advantage of the *super adhesion* of PYRATEx to give greater carcass strength and longer life to *your* tires, hose, belting and other fabric-reinforced rubber goods!

Order a trial drum or truckload today . . . or contact your nearest Naugatuck branch office for further data.



Naugatuck Chemical

**Division of United States Rubber Company
Naugatuck, Connecticut**

BRANCHES: Akron • Boston • Gastonia, N.C. • Chicago • Los Angeles • Memphis • New York • Phila.
IN CANADA: Naugatuck Chemicals, Elmira, Ontario • Rubber Chemicals • Synthetic Rubber •
Plastics • Agricultural Chemicals • Reclaimed Rubber • Latexes • Cable Address: Rubexport, N. Y.

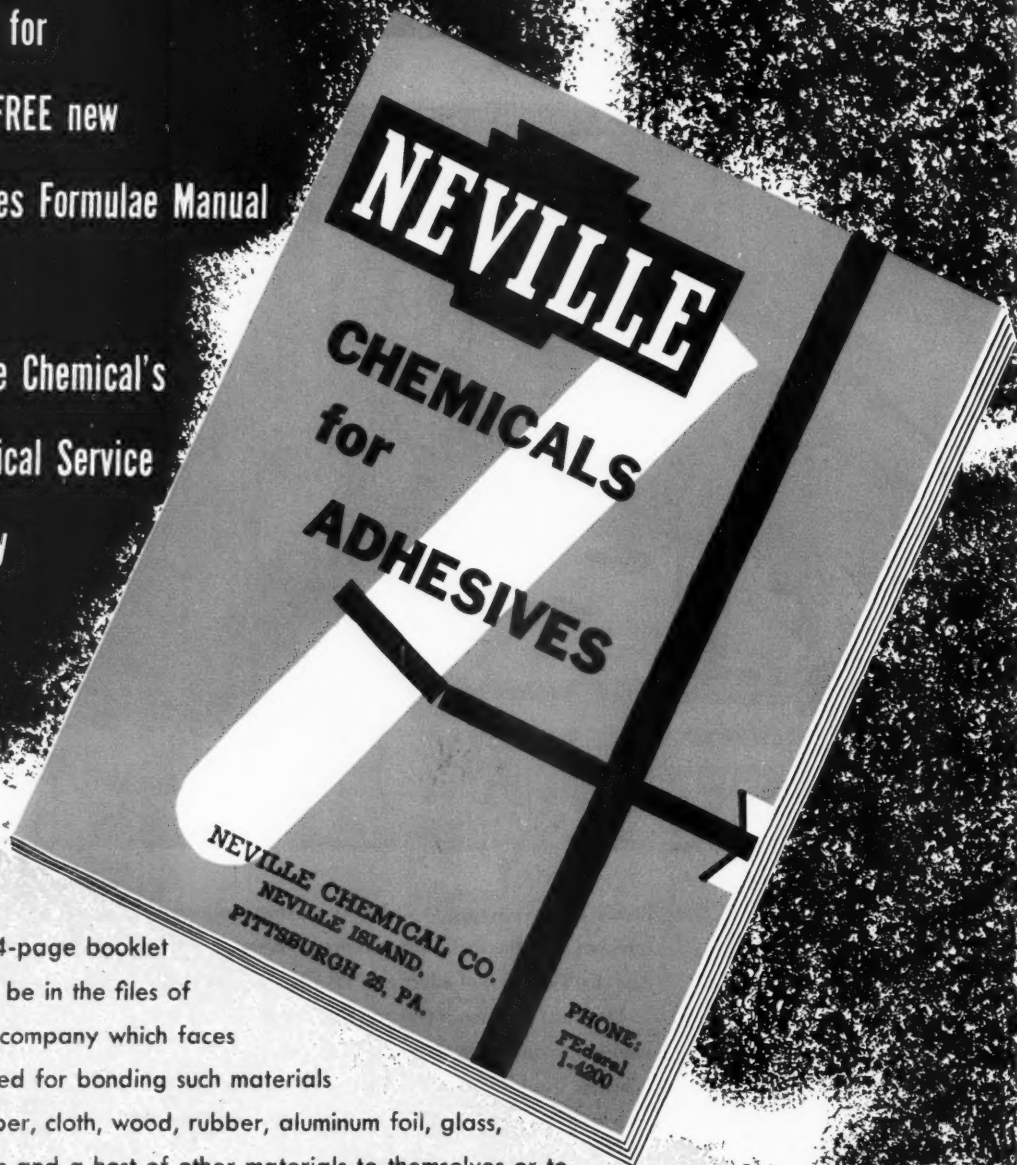


*Naugatuck's trade name for its vinyl pyridine latex.

August, 1957

635

Write for
this FREE new
Adhesives Formulae Manual
from
Neville Chemical's
Technical Service
Library



This 24-page booklet should be in the files of every company which faces the need for bonding such materials as paper, cloth, wood, rubber, aluminum foil, glass, plastics and a host of other materials to themselves or to each other. Sixty-six tested individual formulae are shown and mixing procedures described. Send in the coupon for your free copy.

NEVILLE CHEMICAL COMPANY • Pittsburgh 25, Pa.



Please send a free copy of "Neville Chemicals for Adhesives."

NAME

TITLE

COMPANY

ADDRESS

CITY

NC33-RW

STATE

the
FIRST NAME
and the LAST WORD in
RUBBER and PLASTICS...



MUEHLSTEIN

Backed by over 46 years of progressive management and ever improving technical standards, Muehlstein offers the best in materials and service. Look to Muehlstein for crude rubber, scrap rubber, hard rubber dust, synthetic rubber and all virgin and reprocessed thermoplastics. Technical assistance and newly expanded laboratory facilities are available to solve your particular material problems.

H. MUEHLSTEIN & CO.

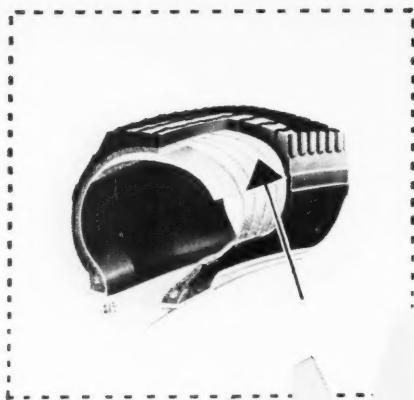
60 EAST 42nd STREET,
NEW YORK 17, N. Y.

REGIONAL OFFICES: Akron • Chicago • Boston • Los Angeles • London • Toronto

PLANTS and WAREHOUSES:

Akron • Chicago • Boston • Los Angeles • Jersey City • Indianapolis

August, 1957

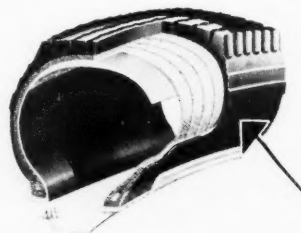


AND

COMING
GOING



ZINC OXIDE SERVES THE RUBBER INDUSTRY WELL



On the 'coming' side, zinc oxide serves the rubber industry because rayon serves it. Rayon is a large consumer of zinc oxide. Rayon finds in the rubber industry its largest single outlet, particularly in the manufacture of passenger car tires. The records show that 99.2% of 1957 passenger car models have rayon cord tires as original equipment.

On the 'going' side, rubber itself is the largest consumer of zinc oxide for processing. As fabricated rubber products go out in the world of commerce zinc oxide can claim more than a modest share in their production. It is essential for the processing of rubber.

St. Joe produces more than thirty different grades of zinc oxide, each have special characteristics and properties. Our technical staff with its well-equipped laboratory is at your service to assist in any application problem.

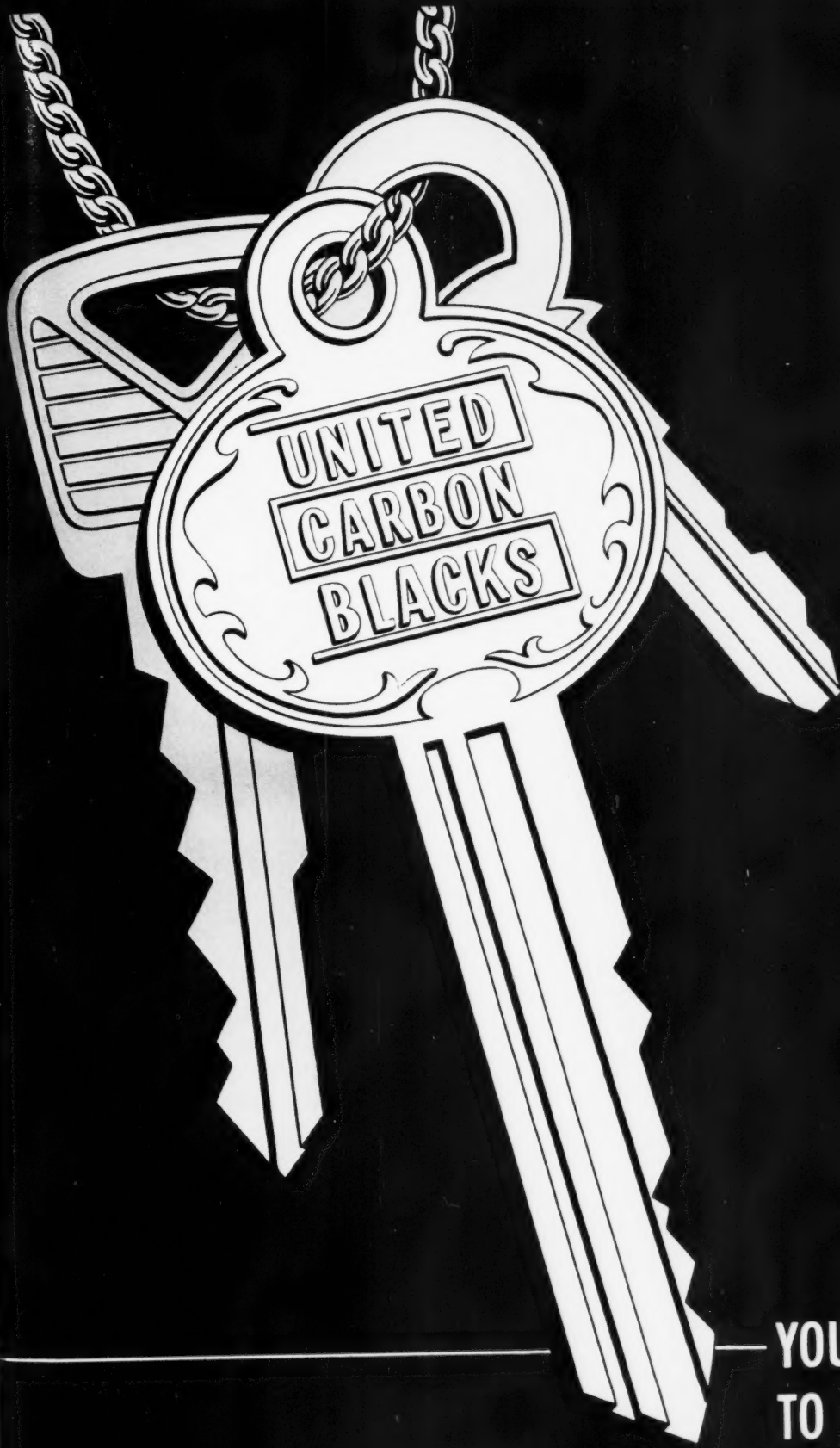
ST. JOSEPH LEAD COMPANY

250 PARK AVENUE, NEW YORK 17, NEW YORK

The Largest Producer of Lead in the United States

ANY

WORLD



— YOUR KEYS
TO
EXCELLENCE

UNITED CARBON BLACKS

... your keys to excellence
for every rubber need. They are the quality blacks,
dependable and helpful in today's rubbers.

-  **KOSMOS 70 ISAF** — Ideal for toughest treads, maximum mileage tires, for gruelling high speed highway operations, and for high electrical conductivity.
-  **KOSMOS 60 HAF** — Recommended for good processing, highest reinforcement, extra mileage tires, tread rubber (camelback), and outstanding resistance to cuts and cracks.
-  **KOSMOS 50 FEF** — Superior as processing aid; for imparting good, smooth, fast extrusions; for maintaining dimensional stability; for dissipating heat.
-  **KOSMOS 40 HMF** — Recommended for good processing, substantial reinforcement, ready dispersion, high rebound, low heat build-up, high resistance to flex.
-  **KOSMOS 35 GPF** — For tire body stocks and general purpose applications where high resiliency, low heat build-up, high strength at elevated temperature and good flex resistance are essential.
-  **KOSMOS 20 SRF** — Excellent for highly loaded rubber goods; easy and cool mixing; semi-reinforcing; low in heat generation; high in resilience.
-  **KOSMOBILE 77 EPC** — Recommended for good processing, for high level of reinforcement, high tensile strength, good resistance to abrasion.
-  **KOSMOBILE S-66 MPC** — For rubber goods requiring high reinforcement, high tensile strength, highest resistance to tear and good resistance to abrasion.
-  **KOSMOS BB (Voltex) CC** — Ideal in polyethylene for resistance to ultraviolet radiation; for coloring of plastics and for high electrical conductivity.

UNITED CARBON COMPANY, INC.

A subsidiary of United Carbon Company

CHARLESTON 27, WEST VIRGINIA

NEW YORK
BOSTON

AKRON
LOS ANGELES

CHICAGO
MEMPHIS



QUESTION

WHAT

will keep this
uncured rubber from

STICKING

when slabbed
or stacked
in storage

ANSWER

A microscopic film of

GLYCERIZED

(LIQUID CONCENTRATE)

LUBRICANT

You won't be able to see it on
the rubber but you will know
of its presence because of the
non-adhesive properties it
imparts. Does not interfere
with tack or knit of stock.

ASK FOR SAMPLE!

QUALITY SINCE 1884

GENSEKE BROTHERS

RUBBER MATERIALS DIVISION

West 48th Place and Whipple Street

Chicago 32, U.S.A.

Also Mfgs. of

RUBBEROL

SYNTHIOL

MICROFLAKE

Another first from Monsanto

SANTONOX... a low-cost method for stabilizing polyethylene during processing... and reducing "greasiness" of finished product.



With as little as .02% Santonox mixed in the batch, extrusions are practically identical to die orifice.

Versatile though it is, the ubiquitous polyethylene polymer gives the processor certain worries... one of which is a lively instability during extruding, blowing, and—to a less degree—during molding. Major trouble is caused by the heat applied in the mixing, milling, and pressuring to shape. Heat causes cross-linking or scission in the molecule. Cross-linking creates a host of headaches: a reduction of flexibility; discoloration; lowered melt flow. But more painful than these to the processor extruding cable insulation, heat-induced cross-linking causes troublesome

"swelling" as the polyethylene extrudes through the orifice and the composition develops a higher electrical-dissipation factor.

Chemically, the remedy was at hand: 4,4'-thiobis-(6-tert-butyl-m-cresol), highly purified, trade named Santonox. Some collaborative study quickly proved how well it *stabilizes* general-purpose and electrical-grade polyethylene against heat degradation.

So little does the trick! Just 0.03% on the weight of the polymer. Checked by ASTM Flow Measurement DI238-52T, the melt index remains constant for the full 45-minute heating. By "Percent-Recovery" test, after 45 minutes of milling, polyethylene with 0.03% Santonox shows only a 5% increase in the index over the unmilled resin. Two other commercial antioxidants tested in parallel show 102% and 83% increases at the same concentration. And even at 1%, these antioxidants permitted an increase in the Percent-Recovery of 18% and 30%, respectively. On the electrical properties side, polyethylene with a concentration of 0.05% Santonox retains virtually the same dissipation factor after 2½ hours' milling.

This little that does so much contributes something still more: the presence of 0.03-0.05% Santonox prevents exudation from the surface. Consequently, finished products are noticeably less "waxy" or greasy to the touch.

The finely crystalline Santonox can be added by either the polyethylene user or the manufacturer of the molding compound. It has been approved by the FDA up to a level of 0.05% in high-pressure polyethylene.

Monsanto's Rubber Chemicals Department will be glad to supply a test sample of Santonox or forward you the names of polyethylene producers whose compounds are supplied already stabilized. Write or call today.

Accelerators—For fast, slow, and regulated rates of safe cure

Antioxidants—For maximum oxidation resistance

Plasticizers

Specialty Processing Compounds

SANTONOX: Trademark of Monsanto Chemical Co.



MONSANTO CHEMICAL COMPANY
Rubber Chemicals Department
Akron 11, Ohio • Telephone: HEmlock 4-1921

when you need

PREMIUM PROPERTIES

AT LOW COST

SPECIFY New Improved **SYNPOL 1708**

Many properties formerly found only in premium priced rubbers, are now available to you in economical SYNPOL 1708.

Because TEXUS SYNPOL 1708 offers low moisture absorption and low ash content, stable light color, excellent flex life and fast cures, it is rapidly replacing many of the standard-priced hot and cold non oil-extended rubbers.

New Improved SYNPOL 1708 has been developed by the use of a new non-staining anti-oxidant, new plant facilities and a new non-volatile pale naphthenic oil used exclusively by TEXUS.

SYNPOL 1708 is particularly economical for such products as wringer rolls, toys, colored specialties, shoe soles, wire insulation and other products formerly requiring a higher priced rubber.

SYNPOL 1708 technical data will be supplied promptly upon request to the TEXUS representative in your area or Naugatuck Chemical, Naugatuck, Connecticut, Sales Agent for TEXUS SYNPOLS.



TEXAS-U.S. CHEMICAL COMPANY

260 Madison Avenue, New York 16, N. Y.

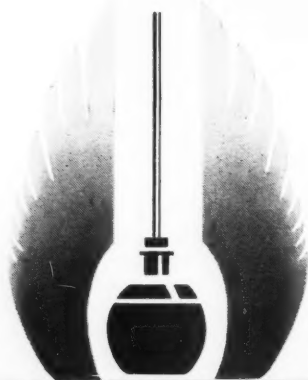
Sales Agent: Naugatuck Chemical, Naugatuck, Conn.

Plants and General Offices: Port Neches, Texas



Quality

one word explains why more firms
than ever before are buying
chemicals from The C. P. Hall Co.



The **C. P. Hall Co.**
CHEMICAL MANUFACTURERS

AKRON, OHIO • LOS ANGELES • CHICAGO, ILL. • NEWARK, N. J. • MEMPHIS, TENN.

SPECIAL PRODUCTS

Para-Flux
2016 Para-Flux
SILICONES
Sponge Paste
PHENEX
SPDX-GH
SPDX-GL
Flexible Paints
Stabilite
Stabilite Alba
Stabilite White
Retardex
Para Resins
STEARIC ACID
CORAX

TECHNICAL & COMPOUNDING MATERIALS

Abrasives
Accelerators
Acids
Activators
Alkalies
Antioxidants
Colors —
Rubber & Plastic
Curing Agents
Dusting Powders
Esters
Fillers
Low Temperature
Plasticizers
Mold Lubricants
Oxides
Plasticizers
Reclaiming Oils
Reinforcing Agents
Solvents

SPECIAL PRODUCTS

ra-Flux
ra-Flux
CONES
Paste
HENEX
DX-GH
DX-GL
Paints
abilite
Alba
White
ardex
Resins
ACID
DRAX

CAL & BONDING MATERIALS

asives
rators
Acids
rators
kalies
dants
ors —
lastic
gents
vders
Esters
Fillers
ature
cizers
cants
xides
cizers
Oils
gents
vents

ORLD

*reasons
why
permanently-
attached
couplings
mean
better
service,
bigger
profits!*

1 PERMANENTLY-ATTACHED HOSE COUPLINGS COST LESS than re-attachable couplings. Modern hose is of such good quality, lasts so long, by the time hose needs replacing so do re-attachable couplings.

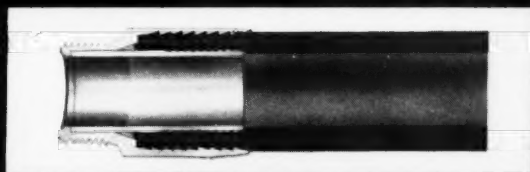
2 CONTINUING ECONOMY WITH PERMANENTLY-ATTACHED COUPLINGS. You do away with hidden expenses involved in reconditioning re-attachable couplings. No time lost, less paper work, no shipping, etc.

3 MACHINE-ATTACHED FOR PRECISION FITTING AND FULL FLOW. You get a permanently fitted coupling every time ... there's never a chance of possible costly damage to hose.

4 LEAK-PROOF WITH FULL-FLOW DIAMETER INSIDE. Scovill permanently-attached couplings are made from solid brass forgings with ductile copper-alloy flow tubes.

For gasoline-pump hose . . . permanently-attached hose couplings by

SCOVILL



For complete specifications on gasoline-pump hose couplings, write to Scovill Manufacturing Co., Merchandise Division, 99 Mill St., Waterbury 20, Conn. Ask for Bulletin No. 570-H.

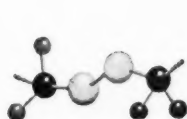


CHECK

the advantages
THIOKOL crude rubbers
and chemicals
offer your product . . .

If you manufacture:	You can get these improved properties:	With these Thiokol Products:
AIR FORCE REFUELING HOSE	Low temperature properties for acrylonitrile rubber tubes and Neoprene type cover.	PLASTICIZER TP-90B
ARCTIC TIRES	Improved low temperature properties.	PLASTICIZER TP-90B
CORK AND FIBROUS MATERIALS	Solvent resistant binder.	FA CRUDE ST CRUDE
COATED ASBESTOS SHEETING	Prevention of solvent evaporation.	A, FA, ST CRUDE
COATED FABRIC FOR GAS METER DIAPHRAGMS	Maximum resistance to gas impermeability with flexibility.	FA CRUDE ST
COATED PAPER AND FELT GASKETS	Solvent resistant coating.	FA CRUDE
DIAPHRAGMS, MOLDED	Low temperature flexibility, solvent resistant. Stocks without plasticizer.	ST CRUDE
GR-S BRAKE CUPS	Plasticizer for low temperatures.	PLASTICIZER TP-90B TP-95

If you manufacture:	You can get these improved properties:	With these Thiokol Products:
MOLDED MECHANICAL GOODS	Low temperature flexibility without the use of extractable plasticizer, increased solvent and compression set resistance. Increased heat resistance and improved aging properties for nitrile and GR-S rubber with non-blooming characteristics.	ST CRUDE VA-7 VULCANIZING AGENT
MOLDED NITRILE MECHANICAL GOODS	Plasticizer for low and high temperature applications.	PLASTICIZER TP-95
"O" RINGS	Low temperature flexibility plus increased solvent resistance. Plasticizer for low temperature flexibility.	ST CRUDE TP-90B PLASTICIZER TP-95 PLASTICIZER
GASKETS	Ultimate solvent resistance.	A, ST CRUDE
PACKINGS	Solvent resistance.	A, FA, ST CRUDE
PAINT SPRAY AND AROMATIC HOSE	Resistance to thinners, lacquers, and solvents.	FA CRUDE
PRINTING AND COATING ROLLERS	Resistance to thinners, lacquers, and solvents.	FA CRUDE ST CRUDE
PROOFED GOODS	Plasticizer for low temperature flexibility.	PLASTICIZER TP-95, TP-90B
PUTTIES	Non-hardening flexible caulking compound.	FA CRUDE
CEMENTS	Solvent resistant coating for paper and cloth.	FA CRUDE
SHEETING	Solvent Resistance.	ST, FA, A CRUDE
TUBING	Low temperature flexibility, solvent resistance, without plasticizer.	ST CRUDE
WIRE AND CABLE	Low temperature flexibility.	PLASTICIZER TP-90B



Thiokol®

PIONEER MANUFACTURER OF SYNTHETIC RUBBER

For more information write: Thiokol Chemical Corporation, 780 North Clinton Avenue, Trenton 7, N. J.

In Canada: Naugatuck Chemicals Division, Dominion Rubber Co., Elmira, Ontario.

*Registered Trademark of the Thiokol Chemical Corp. for its liquid polymers, rocket propellants, plasticizers and other chemical products.



Make new friends with TITANOX*

Your plastic products will really go places when they're pigmented with TITANOX titanium dioxide white pigments. That's because nothing can surpass titanium dioxide for whitening, brightening or opacifying any type of plastic... vinyls, polystyrenes, celluloses.

You will get the maximum benefits from titanium dioxide when you use TITANOX-RA. If you have a plastic pigmentation problem, consult our Technical Service Department. Titanium Pigment Corporation, 111 Broadway, New York 6, N. Y. Offices in principal cities.

TITANIUM PIGMENT CORPORATION
Subsidiary of NATIONAL LEAD COMPANY

*TITANOX is a registered trade mark for the full line of titanium pigments offered by Titanium Pigment Corporation.

5213



COPPO

means pioneering in cold rubber...

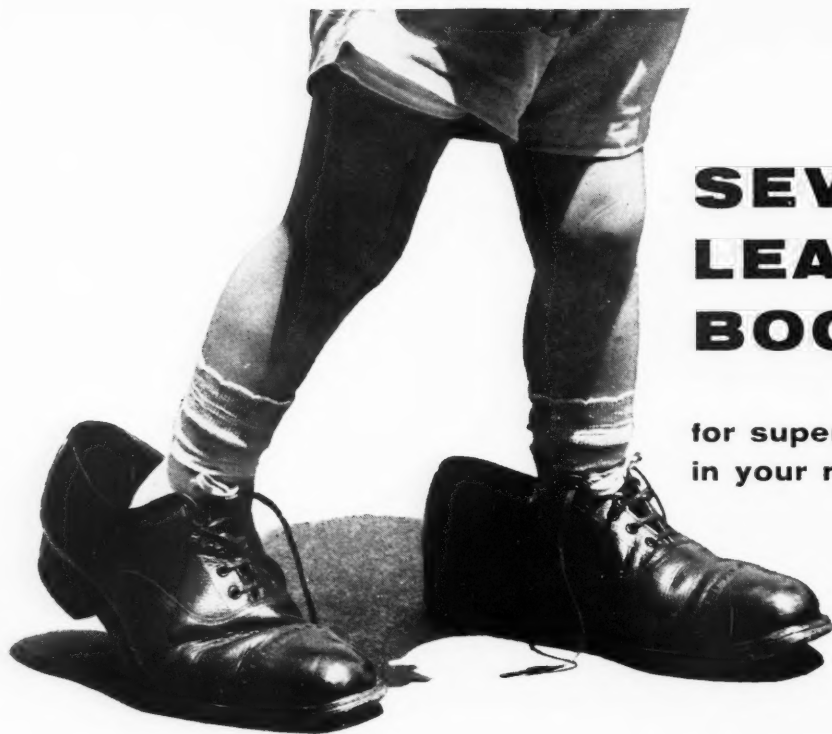
...and pioneering means constant effort
to create and develop SUPERIOR PRODUCTS.

uniformity • well-packaged • high quality • good service

COPOLYMER RUBBER & CHEMICAL CORPORATION • BATON ROUGE 1, LOUISIANA



COLD RUBBER SPECIALISTS



SEVEN LEAGUE BOOTS

for superior processing
in your mixing operations

Marbon "8000-A"®

REINFORCING HIGH STYRENE RESIN

**... the Durable Part
of Durable Soles**

- FOR "ONE-STEP" MIXING OPERATIONS
- REDUCED COST
- INCREASED TOUGHNESS
- GREATER TEAR-RESISTANCE

Whether your problem is the uniform blow of expanded soles, maximum flex-life or resisting abrasion, there is nothing to compare with Marbon 8000-A. This superior-processing resin provides fast fusion at low mixing temperatures, reduced scorch, bright colors, rapid smooth-out . . . all at lower cost. For particular use with Neoprenes and natural rubber.

Get the Facts . . .

Write **TODAY** for
complete **TECHNICAL**
LITERATURE



MARBON CHEMICAL

Division of BORG-WARNER

GARY, INDIANA

MARBON . . . It BLENDS as STRENGTHENS as it IMPROVES

for new equipment, spares or replacements . . .



THERE IS A
UNITED[®]
service-proved
ROLL

UNITED Service-Proved CRACKER ROLLS

- FOR EVERY • RUBBER
• PLASTICS
• LINOLEUM
• TILE
• PAINT
• OR OTHER

NON-METALLIC PROCESSING REQUIREMENT

When you specify UNITED ROLLS, your complete satisfaction is guaranteed by over 50 years' experience in the design and manufacture of rolls for practically every type of rolling application. Precision engineered to the specific requirement of the individual machine or equipment in which they are to be used, UNITED Service-Proved ROLLS are in use the world over by processors of rubber, plastics, linoleum, paper, paint and scores of other metallic and non-metallic substances.

Specify UNITED ROLLS for new equipment, spares or replacements. The experience and advice of our rolls engineers is available without obligation.



UNITED ENGINEERING AND
FOUNDRY COMPANY

PITTSBURGH, PENNSYLVANIA

Plants at • Pittsburgh • Vandergrift • Youngstown
Canton • Wilmington
SUBSIDIARIES: Adamson United Company, Akron, Ohio
Stedman Foundry and Machine
Company, Inc., Aurora, Indiana

Designers and Builders of Ferrous and Nonferrous Rolling Mills,
Mill Rolls, Auxiliary Mill and Processing Equipment, Presses and
other heavy machinery. Manufacturers of Iron, Nodular Iron and
Steel Castings and Weldments.

PROBLEM . . .

"sponginess"



s"

under valve base**SOLUTION . . .**

KURE-BLEND MT

This very problem faced a leading tire tube producer six months ago. The problem was completely solved by adding Kure-Blend MT during stock processing. Several others have proved the same benefits since. This curing problem could have been solved by increasing cure time $\frac{1}{2}$ —1 minute, but Kure-Blend solved it without any increase in time.

Kure-Blend®, a 50 GRS-50 TMTD latex-compounded masterbatch, provides faster, more even dispersion, thus allowing full advantage to be gained from TMTD used for acceleration.

Kure-Blend offers these additional advantages:

- Faster, easier incorporation
- Can be more accurately weighed
- Indefinitely storage-stable
- No dusting
- Assures uniform cure
- No premium cost

There's no need to increase cure time—just add Kure-Blend MT to be sure of tube cure!

For literature and samples, write to:

THE GENERAL TIRE & RUBBER COMPANY

Chemical Division

AKRON, OHIO

Creating Progress Through Chemistry



KURE-BLEND®

IF YOU WANT

Performance plus Economy

YOU NEED

"FLEXOL" PLASTICIZER 426

TRADE-MARK

Low price—that's the big advantage of FLEXOL plasticizer 426—UNION CARBIDE's distilled, mixed alcohol phthalate. But that's not all! This plasticizer has complete compatibility with vinyl chloride resins, low specific gravity, high solvent power, and excellent heat and light stability typical of phthalate esters.

Look at these performance properties of FLEXOL 426 in BAKELITE vinyl resin QYNV:

Plasticizer Concentration, PHR	40	50	60
Durometer A Hardness.....	85	76	68
Elongation at 1000 psi.....	13%	36%	54%
Brittle Temperature.....	-14°C.	-22°C.	-28°C.
Loss from .004 inch film			
Volatile loss [24 Hrs. 70°C. (SPI)].....	7.7%	9.0%	10.3%
Water Extraction (10 days at 23°C.).....	0.1%	0.2%	0.4%
Oil Extraction (10 days at 23°C.).....	4.5%	9.1%	14.1%

FLEXOL 426 is an all-purpose plasticizer. Profile extrusions, electrical insulation and jacketing, vinyl flooring, calendered sheeting, and plastisols are formulated with 426.

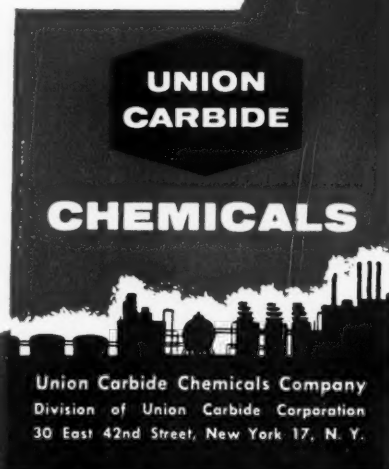
And remember, FLEXOL plasticizer 426 is just one product in UNION CARBIDE's wide selection of plasticizers. Whatever your requirements, there's a FLEXOL plasticizer designed to do the job. For instance,

- FLEXOL DOP (di-2-ethylhexyl phthalate), the general-purpose plasticizer
- FLEXOL 10-10 (di-isodecyl phthalate), for low volatility
- FLEXOL A-26 (di-2-ethylhexyl adipate), for low-temperature performance
- FLEXOL R-2H (a polyester), for extraction resistance
- FLEXOL 380 (a monomeric phthalate), for lacquer mar resistance

This means you can take advantage of the savings due to combination truckload, carload, and bulk shipments. And, UNION CARBIDE's basic raw materials position guarantees you FLEXOL plasticizers in the quantity and quality you want—when you want them.

For more information on 426 and other FLEXOL plasticizers—write Union Carbide Chemicals Company, Department B, 30 East 42nd Street, New York 17, New York. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Toronto.

"Bakelite," "Flexol," and "Union Carbide" are registered trade-marks of Union Carbide Corporation.





Let's sit down and talk things over

Here at Adamson we've been doing something that we believe is rather unique in the industry. Every now and then a manufacturer of rubber or plastics has expressed a desire to discuss certain problems pertaining to calendering or calendering equipment, and we have invited him and his associates to our conference room for a roundtable session with our staff. No one dreamed the idea up—it just grew. Some of the largest manufacturers in the industry have been our guests and have described the meetings as helpful and enlightening.

Certainly, since we build calenders and related equipment, these clinics have been of great value to us. And because we believe that a free exchange of opinions and ideas is the surest way to promote progress and improvement in any industry, we extend to you and your company a cordial invitation to our conference room. Perhaps, like the famous riddle of which came first, the chicken or the egg, many questions will have to be left unanswered, yet the benefits to be derived from a free discussion of our common problems cannot fail to be mutually helpful.

Why not 'phone or write us for a conference date? The obligation will be all ours.



Adamson United Company

730 Central Street • Akron, Ohio

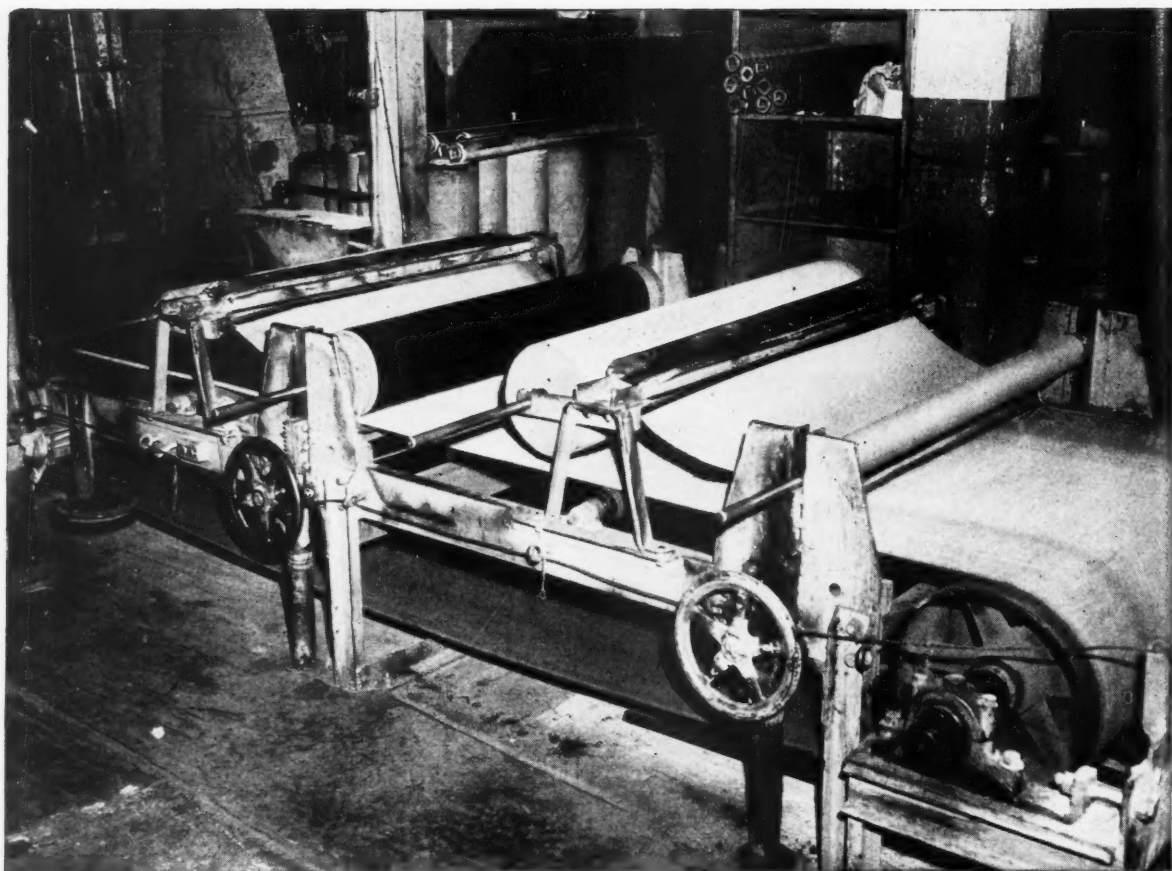
SALES OFFICES IN PRINCIPAL CITIES

Subsidiary of United Engineering and Foundry Company

MAKERS OF: ROLLERS • CALENDERS • MACHINES •
PRESS • EXTRUDERS

**BETTER MACHINES AND PROCESSES FOR
BETTER RUBBER AND PLASTICS PRODUCTS**





CLIMCO LINERS—

to Preserve and Protect Gum Rubber Sheets

Gum rubber sheets are being rolled into durable, clean liners from the calendar. Climco Processed Liners preserve sheet stock; exclude air, moisture, sunlight, maintain tackiness; protect your stock from oxidation, mould, bloom, lint and ravelings.

Climco Processed Liners have been used for 31 years to speed production because they:

- Insure better separation
- Save power
- Eliminate production headaches
- Reduce stock losses

Give greater latitude in compounding
Offer longer liner life

TRY THEM IN YOUR PLANT

THE CLEVELAND LINER & MFG. CO.
5508 Maurice Ave. • Cleveland 27, Ohio

GET THE FULL STORY ON CLIMCO PROCESSING

Illustrated booklet tells about Climco Liners and Linerette separating paper. Tells how to get better service from liners. Write for your copy now.



**LINERETTE
INTERLEAVING
PAPER**

Treatment Contains
NO OIL OR WAX
Samples on Request

CLIMCO

PROCESSED LINERS

FOR FASTER, BETTER PRODUCTION AT LOWER COST



Ever See a Pedigree for Rubber?

**QUALITY REPORT
FR-S RUBBER**
SYNTHETIC RUBBER & LATEX DIVISION
Firestone Tire & Rubber Company
Akron, Ohio

Chicago, Illinois

Public Rubber Company
Car Number MILW-20459
Date Shipped 6-20-57
From Lake Charles, La. 30367
Weight 70,000
L.C. No. LC-6-620

TEST	RESULT	TEST	RESULT
MO. OF BALLS	1500	MO. OF BALLS	1500
ELONGATION	23,000	ELONGATION	23,000
100% MODULUS	1620619	100% MODULUS	1620619
50% MODULUS	330	50% MODULUS	330
20% MODULUS	108	20% MODULUS	108
10% MODULUS	108	10% MODULUS	108
5% MODULUS	108	5% MODULUS	108
2.5% MODULUS	108	2.5% MODULUS	108
1% MODULUS	108	1% MODULUS	108
0.5% MODULUS	108	0.5% MODULUS	108
0.25% MODULUS	108	0.25% MODULUS	108
0.125% MODULUS	108	0.125% MODULUS	108
0.0625% MODULUS	108	0.0625% MODULUS	108
0.03125% MODULUS	108	0.03125% MODULUS	108
0.015625% MODULUS	108	0.015625% MODULUS	108
0.0078125% MODULUS	108	0.0078125% MODULUS	108
0.00390625% MODULUS	108	0.00390625% MODULUS	108
0.001953125% MODULUS	108	0.001953125% MODULUS	108
0.0009765625% MODULUS	108	0.0009765625% MODULUS	108
0.00048828125% MODULUS	108	0.00048828125% MODULUS	108
0.000244140625% MODULUS	108	0.000244140625% MODULUS	108
0.0001220703125% MODULUS	108	0.0001220703125% MODULUS	108
0.00006103515625% MODULUS	108	0.00006103515625% MODULUS	108
0.000030517578125% MODULUS	108	0.000030517578125% MODULUS	108
0.0000152587890625% MODULUS	108	0.0000152587890625% MODULUS	108
0.00000762939453125% MODULUS	108	0.00000762939453125% MODULUS	108
0.000003814697265625% MODULUS	108	0.000003814697265625% MODULUS	108
0.0000019073486328125% MODULUS	108	0.0000019073486328125% MODULUS	108
0.00000095367431640625% MODULUS	108	0.00000095367431640625% MODULUS	108
0.000000476837158203125% MODULUS	108	0.000000476837158203125% MODULUS	108
0.0000002384185791015625% MODULUS	108	0.0000002384185791015625% MODULUS	108
0.00000011920928955078125% MODULUS	108	0.00000011920928955078125% MODULUS	108
0.000000059604644775390625% MODULUS	108	0.000000059604644775390625% MODULUS	108
0.0000000298023223876953125% MODULUS	108	0.0000000298023223876953125% MODULUS	108
0.00000001490116119384765625% MODULUS	108	0.00000001490116119384765625% MODULUS	108
0.000000007450580596923828125% MODULUS	108	0.000000007450580596923828125% MODULUS	108
0.0000000037252902984619140625% MODULUS	108	0.0000000037252902984619140625% MODULUS	108
0.00000000186264514923095703125% MODULUS	108	0.00000000186264514923095703125% MODULUS	108
0.000000000931322574615478515625% MODULUS	108	0.000000000931322574615478515625% MODULUS	108
0.0000000004656612873077392578125% MODULUS	108	0.0000000004656612873077392578125% MODULUS	108
0.00000000023283064365386962890625% MODULUS	108	0.00000000023283064365386962890625% MODULUS	108
0.000000000116415321826934814453125% MODULUS	108	0.000000000116415321826934814453125% MODULUS	108
0.0000000000582076609134674072265625% MODULUS	108	0.0000000000582076609134674072265625% MODULUS	108
0.00000000002910383045673370361328125% MODULUS	108	0.00000000002910383045673370361328125% MODULUS	108
0.000000000014551915228366851806640625% MODULUS	108	0.000000000014551915228366851806640625% MODULUS	108
0.0000000000072759576141834259033203125% MODULUS	108	0.0000000000072759576141834259033203125% MODULUS	108
0.00000000000363797880709171295166015625% MODULUS	108	0.00000000000363797880709171295166015625% MODULUS	108
0.000000000001818989403545856475830078125% MODULUS	108	0.000000000001818989403545856475830078125% MODULUS	108
0.0000000000009094947017729282379150390625% MODULUS	108	0.0000000000009094947017729282379150390625% MODULUS	108
0.00000000000045474735088646411895751953125% MODULUS	108	0.00000000000045474735088646411895751953125% MODULUS	108
0.000000000000227373675443232059478759765625% MODULUS	108	0.000000000000227373675443232059478759765625% MODULUS	108
0.0000000000001136868377216160297393798828125% MODULUS	108	0.0000000000001136868377216160297393798828125% MODULUS	108
0.00000000000005684341886080801486968994140625% MODULUS	108	0.00000000000005684341886080801486968994140625% MODULUS	108
0.000000000000028421709430404007434844970703125% MODULUS	108	0.000000000000028421709430404007434844970703125% MODULUS	108
0.0000000000000142108547152020037174224883515625% MODULUS	108	0.0000000000000142108547152020037174224883515625% MODULUS	108
0.00000000000000710542735760100185871124417578125% MODULUS	108	0.00000000000000710542735760100185871124417578125% MODULUS	108
0.000000000000003552713678800500929355622087890625% MODULUS	108	0.000000000000003552713678800500929355622087890625% MODULUS	108
0.0000000000000017763568394002504646778110439453125% MODULUS	108	0.0000000000000017763568394002504646778110439453125% MODULUS	108
0.00000000000000088817841970012523233890552197265625% MODULUS	108	0.00000000000000088817841970012523233890552197265625% MODULUS	108
0.000000000000000444089209850062616169452760986328125% MODULUS	108	0.000000000000000444089209850062616169452760986328125% MODULUS	108
0.0000000000000002220446049250313080847263804931640625% MODULUS	108	0.0000000000000002220446049250313080847263804931640625% MODULUS	108
0.00000000000000011102230246251565404236319024658203125% MODULUS	108	0.00000000000000011102230246251565404236319024658203125% MODULUS	108
0.000000000000000055511151231257827021181595123291015625% MODULUS	108	0.000000000000000055511151231257827021181595123291015625% MODULUS	108
0.0000000000000000277555756156289135105907975616455078125% MODULUS	108	0.0000000000000000277555756156289135105907975616455078125% MODULUS	108
0.00000000000000001387778780781445675529539878082275390625% MODULUS	108	0.00000000000000001387778780781445675529539878082275390625% MODULUS	108
0.000000000000000006938893903907228377647699390411376953125% MODULUS	108	0.000000000000000006938893903907228377647699390411376953125% MODULUS	108
0.0000000000000000034694469519536141888238496952056884765625% MODULUS	108	0.0000000000000000034694469519536141888238496952056884765625% MODULUS	108
0.00000000000000000173472347597680709441192484760284423828125% MODULUS	108	0.00000000000000000173472347597680709441192484760284423828125% MODULUS	108
0.000000000000000000867361737988403547205596242301422119140625% MODULUS	108	0.000000000000000000867361737988403547205596242301422119140625% MODULUS	108
0.0000000000000000004336808689942017736027981211510110596875% MODULUS	108	0.0000000000000000004336808689942017736027981211510110596875% MODULUS	108
0.00000000000000000021684043449710088680139906057550552984375% MODULUS	108	0.00000000000000000021684043449710088680139906057550552984375% MODULUS	108
0.000000000000000000108420217248550443400699530287752764921875% MODULUS	108	0.000000000000000000108420217248550443400699530287752764921875% MODULUS	108
0.0000000000000000000542101086242752217003497651438763824609375% MODULUS	108	0.0000000000000000000542101086242752217003497651438763824609375% MODULUS	108
0.00000000000000000002710505431213761085017488257193819123046875% MODULUS	108	0.00000000000000000002710505431213761085017488257193819123046875% MODULUS	108
0.0000000000000000000135525271560688054250874412859690561523046875% MODULUS	108	0.0000000000000000000135525271560688054250874412859690561523046875% MODULUS	108
0.0000000000000000000067762635780344027125437206429845280761523046875% MODULUS	108	0.0000000000000000000067762635780344027125437206429845280761523046875% MODULUS	108
0.0000000000000000000033881317890172013562718603214922640380761523046875% MODULUS	108	0.0000000000000000000033881317890172013562718603214922640380761523046875% MODULUS	108
0.0000000000000000000016940658945086006781359301607461320190380761523046875% MODULUS	108	0.0000000000000000000016940658945086006781359301607461320190380761523046875% MODULUS	108
0.0000000000000000000008470329472543003390679650803730660095190380761523046875% MODULUS	108	0.0000000000000000000008470329472543003390679650803730660095190380761523046875% MODULUS	108
0.0000000000000000000004235164736271501695339825401865330047595190380761523046875% MODULUS	108	0.0000000000000000000004235164736271501695339825401865330047595190380761523046875% MODULUS	108
0.0000000000000000000002117582368135750847669912700932665023797595190380761523046875% MODULUS	108	0.0000000000000000000002117582368135750847669912700932665023797595190380761523046875% MODULUS	108
0.0000000000000000000001058791184067875423834956350466332511898797595190380761523046875% MODULUS	108	0.0000000000000000000001058791184067875423834956350466332511898797595190380761523046875% MODULUS	108
0.00000000000000000000005293955920339377119172781752331662559494398797595190380761523046875% MODULUS	108	0.00000000000000000000005293955920339377119172781752331662559494398797595190380761523046875% MODULUS	108
0.00000000000000000000002646977960169688559586390876165831279747199398797595190380761523046875% MODULUS	108	0.00000000000000000000002646977960169688559586390876165831279747199398797595190380761523046875% MODULUS	108
0.00000000000000000000001323488980084844277793195438082915639873599699398797595190380761523046875% MODULUS	108	0.00000000000000000000001323488980084844277793195438082915639873599699398797595190380761523046875% MODULUS	108
0.00000000000000000000000661744490042422138896597719041457819936799849699398797595190380761523046875% MODULUS	108	0.00000000000000000000000661744490042422138896597719041457819936799849699398797595190380761523046875% MODULUS	108
0.00000000000000000000000330872245021211069448298859520728959968399924849699398797595190380761523046875% MODULUS	108	0.00000000000000000000000330872245021211069448298859520728959968399924849699398797595190380761523046875% MODULUS	108
0.00000000000000000000000165436122510605534724149429760364479984199962424849699398797595190380761523046875% MODULUS	108	0.00000000000000000000000165436122510605534724149429760364479984199962424849699398797595190380761523046875% MODULUS	108
0.0000000000000000000000008271806125530277686207471488018222399920999931212424849699398797595190380761523046875% MODULUS	108	0.0000000000000000000000008271806125530277686207471488018222399920999931212424849699398797595190380761523046875% MODULUS	108
0.000000000000000000000000413590306276513893310373574400911119996049996560621212424849699398797595190380761523046875% MODULUS	108	0.000000000000000000000000413590306276513893310373574400911119996049996560621212424849699398797595190380761523046875% MODULUS	108
0.00000000000000000000000020679515313825694665518678720045559998024999828031060621212424849699398797595190380761523046875% MODULUS	108	0.00000000000000000000000020679515313825694665518678720045559998024999828031060621212424849699398797595190380761523046875% MODULUS	108
0.000000000000000000000000103397576569128473327593393600227799990124999140155031060621212424849699398797595190380761523046875% MODULUS	108	0.000000000000000000000000103397576569128473327593393600227799990124999140155031060621212424849699398797595	



**EXPAND
ALIGNER**

ROLL CAMBER ADJUSTED BY FABRIC EDGE GAGE
FOR PRECISE CONTROL OF WIDTH, CENTERING AND EDGE
CONDITION OF TIRE FABRICS AND OTHER OPEN WEAVES
DURING WEB PROCESSING . . . Bulletin on Request

C. A. LITZLER CO., INC.
1817 BROOKPARK RD. CLEVELAND 9, OHIO CABLE "CALITZ"
EXPORT REPRESENTATIVE: GILLESPIE & CO. OF N. Y., 96 WALL ST., NEW YORK 5, N. Y.

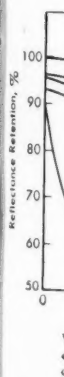
Manufacturers of CANARY LINERS

Mildew-proofing *and* Flame-proofing
Cotton Fabrics as per Government
Specifications. *Write or Wire for Samples
and Quotations.*

EXPORT AGENT
Columbian Carbon International, Inc.
380 Madison Ave., New York
17, N. Y.

CANADIAN AGENT
Columbian Carbon (Canada) Ltd.
Carbon Black and Pigment Division
7 Superior Avenue
Toronto 14, Ontario, Canada

J. J. WHITE Products Co.
7000 UNION AVENUE
CLEVELAND 5, OHIO





Color stability of TiO_2 -loaded, Dutrex 33-extended SBR stocks after severe exposure to artificial sunlight.

Sample designation—reading clockwise

1707—GRS-1707

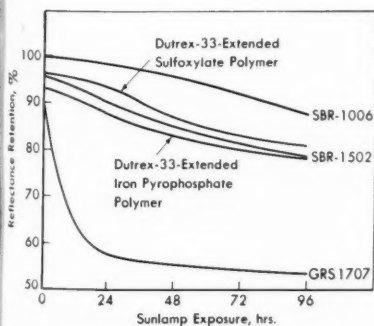
Dutrex 33—SBR-37.5 phr Dutrex 33-extended iron pyrophosphate polymer

1502—SBR-1502

Dutrex 33—SBR-37.5 phr Dutrex 33-extended sulfoxylate polymer

1006—SBR-1006

Non-staining extending oil for light-colored rubber stocks



Whiteness retention of TiO_2 -loaded, Dutrex 33-extended SBR stocks. (Reflectance retention compared to unexposed S-1006 control.)

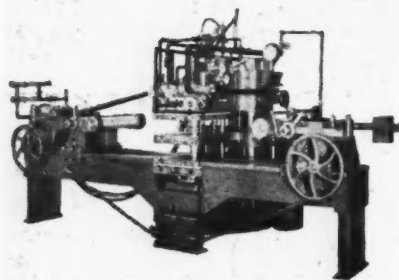
Shell Dutrex® 33 is a superior naphthenic extender for SBR combining extremely light color and outstanding color stability with good compatibility and low volatility. This attractive balance of properties now provides practical oil-extended SBR stocks with staining and discoloration resistance approaching the best oil-free SBR types.

The outstanding resistance of Dutrex 33-extended SBR stocks to discoloration by severe sun lamp exposure is shown in the

accompanying illustrations. Results indicate that Dutrex 33-extended SBR may serve in some applications where critical discoloration and contact or migration staining resistance have previously demanded use of oil-free types.

For additional information, write or call Shell Oil Company, 50 West 50th Street, New York 20, N. Y., or 100 Bush Street, San Francisco 6, California.

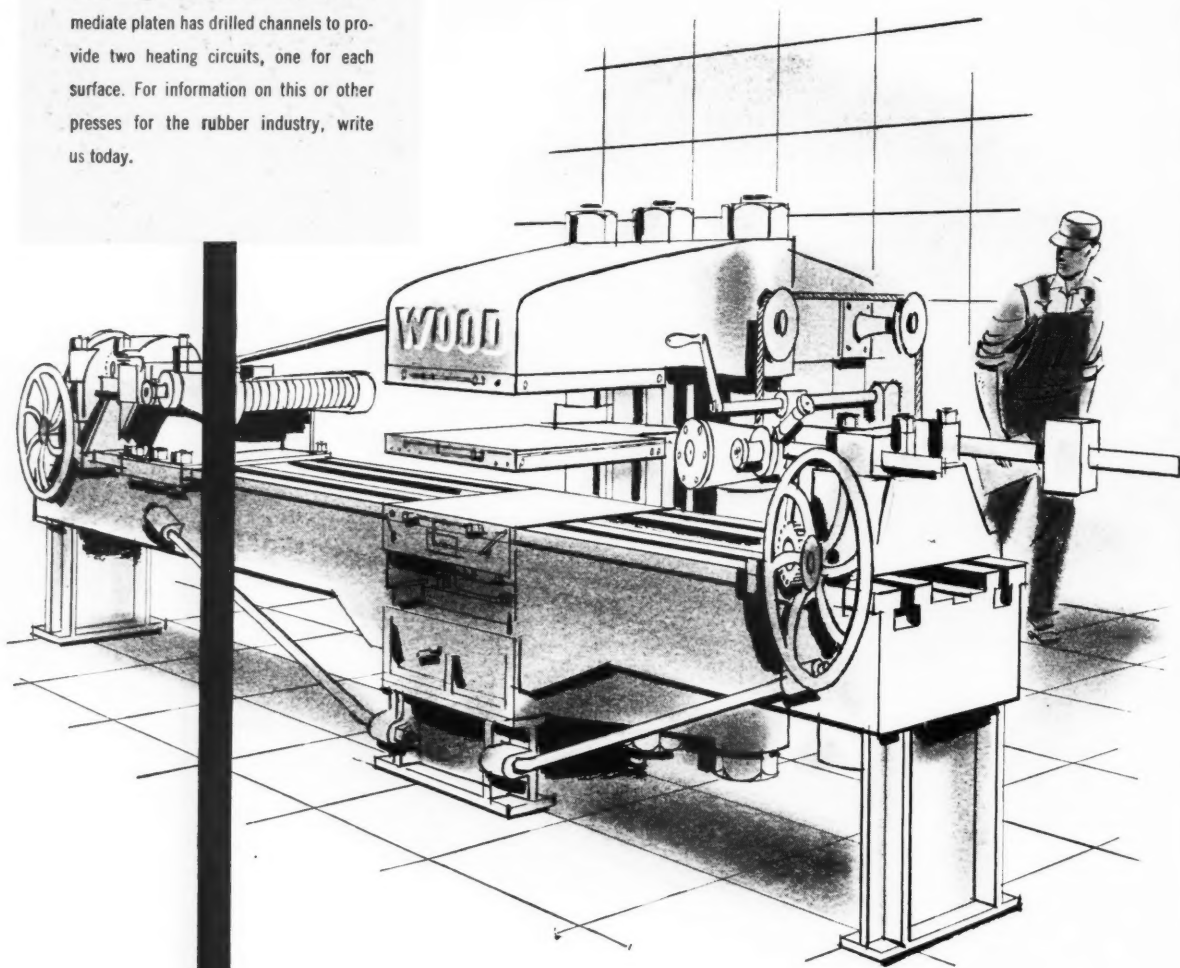
SHELL DUTREX 33



Open Gap 47-Ton Belt Press for curing flat and V-type transmission belts. The moving platen is accurately machined from a rolled steel slab and is guided by long, full-round babbitted guides on the strain rods. Intermediate platen has drilled channels to provide two heating circuits, one for each surface. For information on this or other presses for the rubber industry, write us today.

Prelude to low-cost production

When an R. D. Wood Press swings into action, gratifying things happen to production costs. For, in most cases, production climbs to a new high and downtime for repairs approaches zero. The reason is the smooth, dependable performance of R. D. Wood Presses—even under difficult conditions. And the reasons for this superior performance are the exacting standards set by R. D. Wood—in design, selection of materials, and craftsmanship. If your company's theme is low-cost production, here is your prelude—ready made.



R. D. WOOD COMPANY

PUBLIC LEDGER BUILDING • PHILADELPHIA 5, PENNSYLVANIA



Typical examples of the tubular wire braid, flat wire braid, wire tape, rope and strand developed and produced by National-Standard especially for the rubber industry.

Wherever wire and rubber work together...

• For half a century, National-Standard has dedicated large scale research and engineering to improving the teamwork of wire and rubber. It is still going on . . . extensive work on wire fabrication, finish, corrosion, strength, elongation, adhesion and other factors that can affect the behavior and cost of your wire-in-rubber products.

So, wherever wire and rubber must work together, it is more than likely that National-Standard can contribute—particularly where new production or new service requirements are involved. We want to be of help . . . and are geared to do it well, without obligation. Check with us now . . . or anytime!

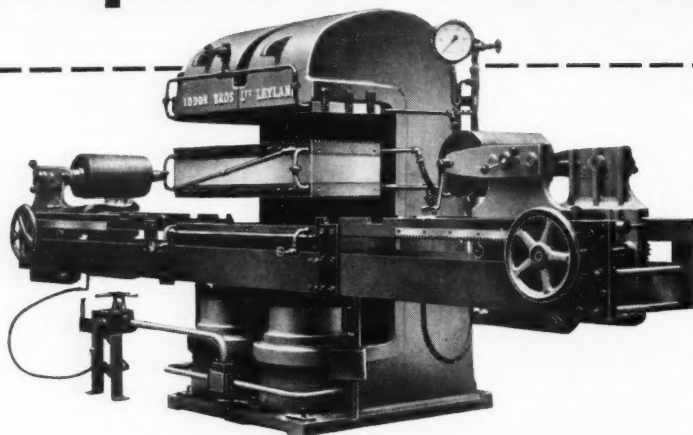
NATIONAL



STANDARD

DIVISIONS: NATIONAL-STANDARD, Niles, Mich.; tire wire, stainless, music spring and plated wires • WORCESTER WIRE WORKS, Worcester, Mass.; high and low carbon specialty wires
WAGNER LITHO MACHINERY, Secaucus, N. J.; metal decorating equipment • ATHENIA STEEL, Clifton, N. J.; flat, high carbon spring steels • REYNOLDS WIRE, Dixon, Ill.; industrial wire cloth

If it's a question of Economics...



18" x 48" Vee Belt
Vulcanizing Press
fitted with hydraulic
stretching gear de-
signed to produce
belts of accurate
length.

One range of Vee
Belt Presses cover
circumferences of
from 30 in. to 400
in.; all designed
with the object of
assuring econom-
ical production of
all sizes.

U.S. AND CANADIAN
Technical Sales and Service:

WILMOD COMPANY (Rubber Division),

2488 DUFFERIN STREET, TORONTO 10, CANADA

Telephones: Toronto RUssell 1-5647 and 1-5648. Cables: WILmo, Can. Toronto

IDDON

BROTHERS LIMITED

LEYLAND, LANCASHIRE, ENGLAND

Cables: IDDON. LEYLAND. ENGLAND. Phones: LEYLAND 81258-9

Specialists for 75 years in the design and manufacture of Rubber and Plastics Machinery



**SYNTHETIC
RUBBER**

**CRUDE
RUBBER**

**NEVILLE
CHEMICALS**

**LIQUID
LATEX**

E. P. LAMBERT CO.

FIRST NATIONAL TOWER

AKRON 8, OHIO

HEmlock 4-2188

Member - Commodity Exchange, Inc.

**COUMARONE RESINS
RECLAIMING OILS
PLASTICIZERS
POWDERED RUBBER**

RUBBER WORLD

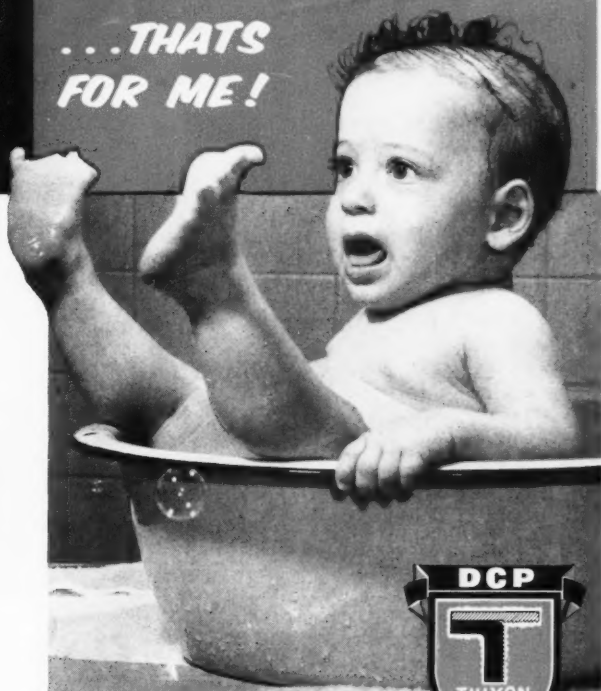
August

THIXON

Prevents Slips?

Of course we are talking about the slips and separations that you may have experienced when you are trying to bond rubber to metal . . . They, too, might be just as vexing . . .

...THATS
FOR ME!



THIXON

BONDING AGENTS...

*will give you a Specific Answer to any
Rubber - to - Metal bonding problem*

● Your special problems in adhesion are handled with speed and efficiency in the THIXON laboratory . . . Your problem stock will be checked for adhesion against a sample of your metal using standard bonding agents or experimentals — or special cements will be prepared to solve stubborn problems . . .

The proper bonding agent for joining rubber to aluminum, steel, brass; Acrylonitrile to steel, Neoprene to brass plate, Butyl to brass, GR-S to steel or brass . . . The best bonding agent for your job is available to you in any quantity whether made in the laboratory or as a production run.

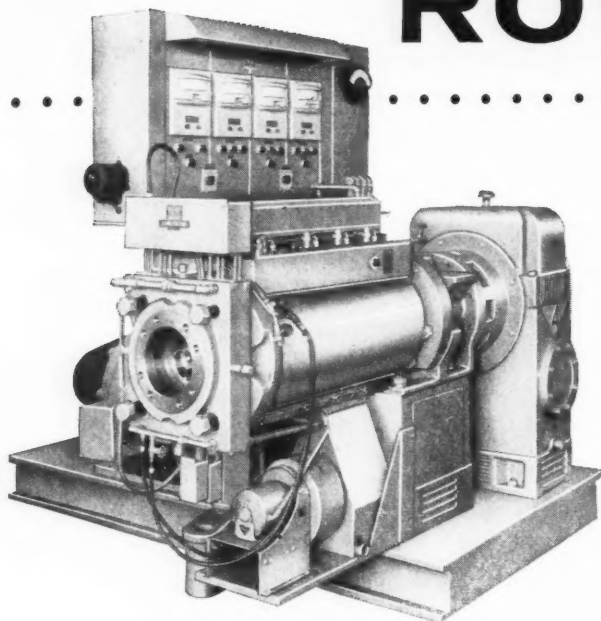
WHERE SERVICE COUNTS

●
Special attention is given to your bonding problems — small or large . . . Our laboratory technicians know bonding problems from the experience of meeting hundreds for many manufacturers with a SURE and SAVING answer.



THIXON is a product of
Dayton Chemical Products Lab., Inc.
West Alexandria, Ohio

THIXON is distributed by
HARWICK STANDARD CHEMICAL CO.
THROUGH IT'S OFFICES IN AKRON, BOSTON, CHICAGO, TRENTON, ALBERTVILLE, ALA.



ROYLE

SPIROD[®] EXTRUDERS

These all electric extruders with radiant heat and high velocity evaporative cooling are designed to process either plastic or rubber compounds. The result of more than three quarters of a century of experience — Royle pioneered the extrusion process in 1880 — in the design and construction of extruding machines time tested features have been built into Spirod to assure dependability.

Write for Bulletin # 463

JOHN ROYLE & SONS



PIONEERED THE CONTINUOUS EXTRUSION[®] PROCESS IN

London, England
James Day (Machinery) Ltd.
Hyde Park 2430 - 0456

Home Office
V. M. Hovey J. W. VanRiper
SHerwood 2-8262

Akron, Ohio
J. C. Clinefelter
BLackstone 3-9222

Los Angeles, Cal.
H. M. Royal, Inc.
LUdlow 9-3261

Tokyo, Japan
Okura Trading Co., Ltd.
(56) 2130 - 2149

"7th inning" Stretch

m — mm — wonderful!
Claremont Cotton Flock
gives Rubber that
much-to-be-desired Stretch.

What's more... Cotton Flock
bolsters the batch... extends its
volume... and betters its quality!
When flock-filled, Rubber
stands up to the toughest tasks!

Write for
PRICES
SAMPLES
DETAILS
to

CLAREMONT WASTE MFG. CO.
World's Largest Maker of Flock
CLAREMONT NEW HAMPSHIRE

VINYL TIRE PARTS TUBES

Woloch for RUBBER

SCRAP · CRUDE
ALLIED MATERIALS

george **Woloch** CO., INC.

601 West 26th Street, New York 1, N. Y.

Phone ORegon 5-2350
CABLE
GEOWOLOCH — New York

OFFICES AND WAREHOUSES:

601 West 26th Street
New York 1, N. Y.
ORegon 5-2350

1587 Water Street
Cuyahoga Falls, Ohio
SWandale 4-5237

1082 Norita Street
Akron, Ohio

1587 Water Street
Cuyahoga Falls, Ohio
432 First Street
Jersey City, N. J.

601 West 26th St.
New York 1, N. Y.

514 West 24th St.
New York 1, N. Y.

TIRES

POLYETHYLENE

BUFFINGS

UNCURED FRICTION

COMPOUNDS

CAMEL BACK ENDS

S

E

80

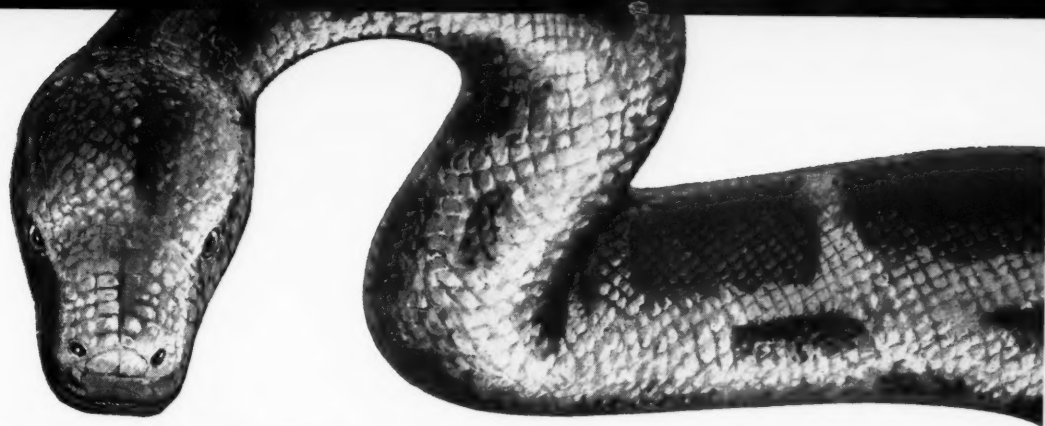
td.

UNCURED FRICTION

COMPOUNDS

CAMEL BACK ENDS

ORLD



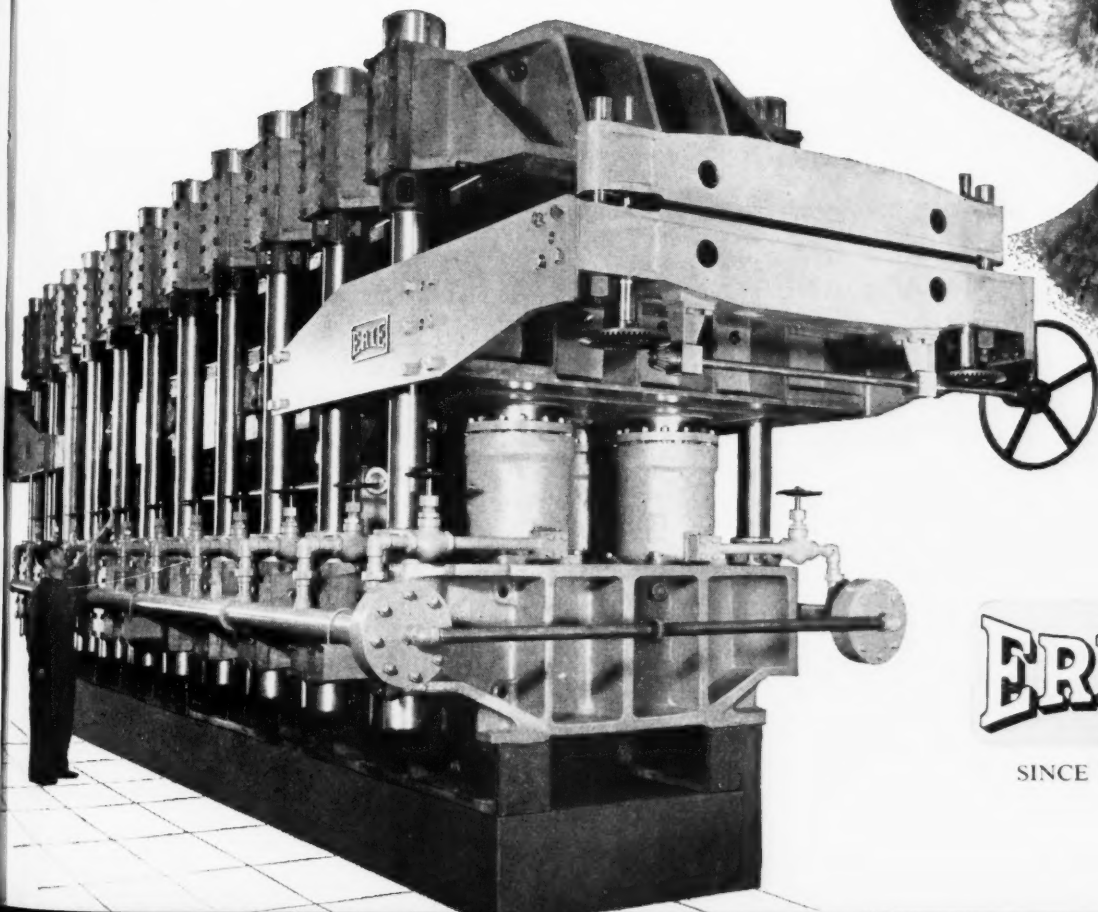
THERE'S A PYTHON-LIKE SQUEEZE IN THIS 4000-TON ERIE BELT PRESS

Here is one of the largest belt presses ever built. It is the type of job which is routine specialization for Erie Foundry. The press has twenty-two 16" rams with a 14" stroke, and a 14" opening which will cure a conveyor belt 68" wide by 30' long. Weighing over 400,000 pounds, its base area is 8' x 30'. And the specially designed MECHANICAL STRETCHER assures even stretching of the belt on each and every cure cycle.

If you are considering a new compression press, consult ERIE FOUNDRY—the builders whose experience and know-how cover a broad range of hydraulic presses. Please write for more information.

Hydraulic Press Division

ERIE FOUNDRY CO. ERIE 7, PA.



ERIE

SINCE 1895



Vulcanized **VEGETABLE OILS**

rubber substitutes

Types, grades and blends
for every purpose, wherever
Vulcanized Vegetable Oils
can be used in production
of Rubber Goods—
be they Synthetic, Natural,
or Reclaimed.

A long established and proven product.

THE CARTER BELL MFG. CO.
SPRINGFIELD, NEW JERSEY

Represented by
HARWICK STANDARD CHEMICAL CO.

Akron, Boston, Chicago, Los Angeles, Trenton,

Albertville, (Ala.), Denver



The Institution of the Rubber Industry L O N D O N

The I.R.I., which was founded in 1921, is now a great association of people engaged in all branches of the Rubber Industry. Its members include rubber producers, manufacturers, scientists, technologists, executives, students and others, in many countries of the world.

It has reached its present position of authority and respect through the high standard it has set for the technical literature it publishes, the diplomas it awards, and the meetings and conferences it organizes.

In collaboration with other Societies, it aims to raise the standing of the Industry throughout the world by improving the technical qualifications of its personnel, extending the study of its raw materials, processes, and products, and by promoting the exchange of technical discovery and information by means of literature, conferences, and meetings.

Membership of the Institution is open to all interested at an annual subscription of \$7.50 which entitles the member to receive the bi-monthly Transactions free of charge and to purchase other publications (such as the Annual Reports and Monographs) at reduced rates. It also serves to put him in touch with his colleagues and their work in other parts of the world and confers on him full rights to vote, to nomination for election to the Council and to participate in meetings and Conferences organized by the Institution.

*Complete details are easily obtained
by writing to:*

SECRETARY
INSTITUTION OF THE RUBBER INDUSTRY
4, KENSINGTON PALACE GARDENS
LONDON, W. 8, ENGLAND



FLOOR TILE?

For top quality and sparkling color, too
... *make it from*

SHELL SYNTHETIC RUBBER



IF YOU WANT the tile you make to be the *best* . . . if you're looking for brighter colors and better color stability . . . use improved Shell S-1006 hot or S-1502 cold rubber.

Both are excellent for other products, too—light-colored mechanicals, sporting goods, shoe soles and heels.

The Shell Chemical plant at Torrance, California produces a full line of butadiene-styrene-type synthetic rubber to fill the needs of large and small Western manufacturers. Available types include hot, cold, oil-extended and black masterbatch rubber as well as hot and cold latices.

Whatever you manufacture from rubber, convenient location and diversity of product make Shell Chemical your logical rubber source in the West. Remember too—Shell's Technical Service Laboratory is ready to help you find practical solutions for troublesome technical problems.

Think of Torrance, California, whenever you need synthetic rubber. Write or phone for a catalog and information on specific types. Our phone number in Los Angeles is FAculity 1-2340

SHELL CHEMICAL CORPORATION

Synthetic Rubber Sales Division
P. O. Box 216, Torrance, California



HYPALON[®] IS

Effective July 26, the price of HYPALON* 20 has been reduced to 70¢ a pound, f.o.b. Beaumont, Texas. This reduction creates new sales opportunities for makers of rubber products. • Because of its marked superiority in resistance to oxidation, chemicals and ozone, and its

*Reg. U. S. Pat. Off.

Here are applications where rubber chemists have used the outstanding



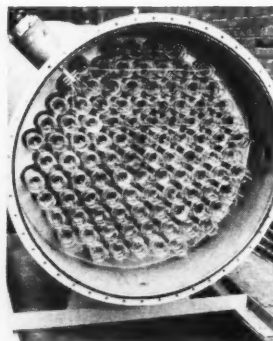
TARPAULINS

HYPALON for resistance to scuffing, sun and weather



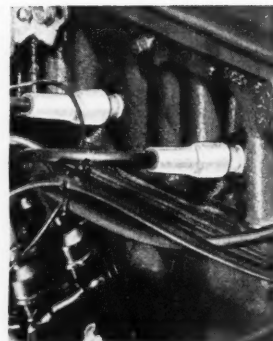
CONVERTIBLE TOPS

HYPALON for weatherability, color stability and cleanability



OZONE GENERATOR GASKETS

HYPALON for ozone resistance



SPARK PLUG BOOTS

HYPALON for heat and ozone resistance



ACID HOSE

HYPALON for resistance to strong acids



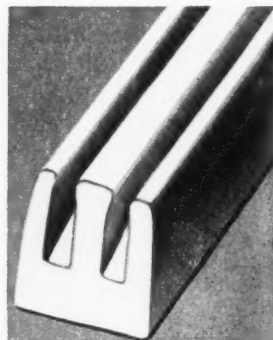
WEATHERSTRIP COATINGS

HYPALON for sun and weather resistance, color stability



COLORLED PHONE CORDS

HYPALON for scuff resistance and color stability



AIRPLANE WINDOW SEALS

HYPALON for sun and weather resistance, color stability

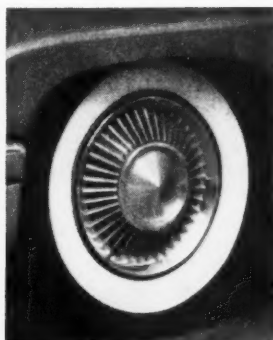
S REDUCED 15¢

ability to take on and retain brilliant colors, HYPALON can be used in applications where other types of rubber have proved inadequate or completely unsuitable. And with the reduced price, goods made with HYPALON can now be offered at much more attractive prices.

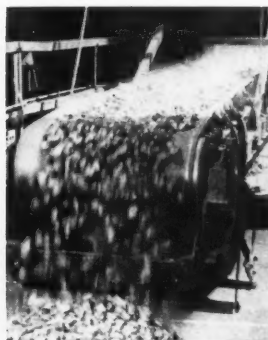
properties of HYPALON to create new products or make existing products better



INDUSTRIAL ROLLS
HYPALON for heat and chemical resistance



WHITE SIDEWALLS
HYPALON blends for atmospheric ozone resistance, color stability.



HOT CONVEYOR BELTS
HYPALON for abrasion and heat resistance



LINEMAN'S BLANKETS
HYPALON for corona-cutting and ozone resistance

Want more information? Your Du Pont representative will be glad to discuss HYPALON with you.

E. I. du Pont de Nemours & Co. (Inc.)
Elastomer Chemicals Dept., Wilmington 98, Delaware

DISTRICT OFFICES:

Akron 8, Ohio, 40 E. Buchtel Ave.	Portage 2-8461
Atlanta, Ga., 1261 Spring St., N.W.	TRinity 5-5391
Boston 10, Mass., 140 Federal St.	HAncock 6-1711
Charlotte 2, N. C., 427 West Fourth St.	FRanklin 5-5561
Chicago 3, Ill., 7 South Dearborn St.	ANdover 3-7000
Detroit 35, Mich., 13000 West 7-Mile Rd.	UNiversity 4-1963
Houston 25, Texas, 1100 E. Holcombe Blvd.	JAckson 9-2666
Los Angeles 58, Calif., 2930 E. 44th St.	LUdlow 2-6464
Trenton 8, N. J., 1750 North Olden Ave.	EXport 3-7141

In Canada contact Du Pont Company of Canada (1956) Limited, Box 660, Montreal

HYPALON
SYNTHETIC RUBBER



REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING... THROUGH CHEMISTRY

Maggie's DCI'sion:

Everyone gets burned up at times—but there is no use letting your Neoprene get in the act. Even if you and the weather are scorching. Keep your stocks from burning with D C I Light Magnesium Oxide. Give us a call to save your money—and your disposition. Write for *NEW*, complete catalog.

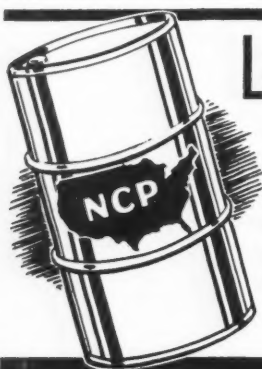


DARLINGTON CHEMICALS, INC.

1420 Walnut St., Philadelphia 2, Pa.

Represented by

Summit Chemical Co., Akron
Tumpeier Chemical Co., Chicago
The B. E. Dougherty Co.,
Los Angeles and San Francisco



Lacquers for Rubber...

Manufacturers of quality lacquer products for industry, equipped to fill your lacquer needs quickly and economically.

CLEAR AND COLORED

- **NEW**, improved LACQUERS for Rubber Footwear, or any rubber product where lacquer is used as a pre-cure coating.
- **SOLE and HEEL LACQUERS**. Eliminate seconds by using our special pigmented lacquers. Can be supplied in any color desired.
- **NCP 1909**. An anti-tack coating. Spray or brush it on any tacky surface where powder is normally used to kill tack before cure.
- **CASUALS**, footwear. NCP 1909 is an excellent dulling and anti-tack agent on edges of soles or crepe wrappers used in the manufacturing of casual type footwear.
- **SPECIAL** lacquers for all types of rubber products.

Write for complete details

The National Chemical & Plastics Co.

1424 Philpot Street • Baltimore 31, Maryland

Clean properly before preparing metal for rubber bonding

new ideas
in cleaning
for the
rubber
industry

BEFORE metal can be conditioned for rubber bonding, it first must be freed of soils. It must be properly etched to provide a receptive surface. Otherwise the adhesive cement cannot develop a strong tenacious hold. Also, it must be left inert to prevent corrosion from forming under the rubber. Regardless of the size or volume of work, type of metal or soil, Oakite offers several methods of conditioning metal surfaces for rubber bonding—by barrel, tank or hand. Also a wide number of Oakite materials for use on steel, iron and aluminum.

Write for details. No obligation. Oakite Products, Inc., 47 Rector Street, New York 6, N. Y.



Export Division
Cable Address: Oakite

Technical Service Representatives in Principal Cities of U. S. and Canada

ERIE ENGINE & MFG. CO. complete installations for REINFORCED PLASTICS MOLDING



including

PRESSES

HYDRAULIC UNITS

PREFORM MACHINES

ROVING CUTTERS

OVENS

Consult us for specifications and quotation for any complete or partial Fiberglass Molding installations.

**CALL OR WRITE
FOR COMPLETE DETAILS**

Downward acting Reinforced Plastics Molding Press, specially designed and built to suit a specific need.

EEMCO

ERIE ENGINE & MFG. CO.

951 East 12th St., ERIE, PA.

National NADONE*

(CYCLOHEXANONE)

- By the drum from nearby stocks
- By the tank car from Hopewell, Va.

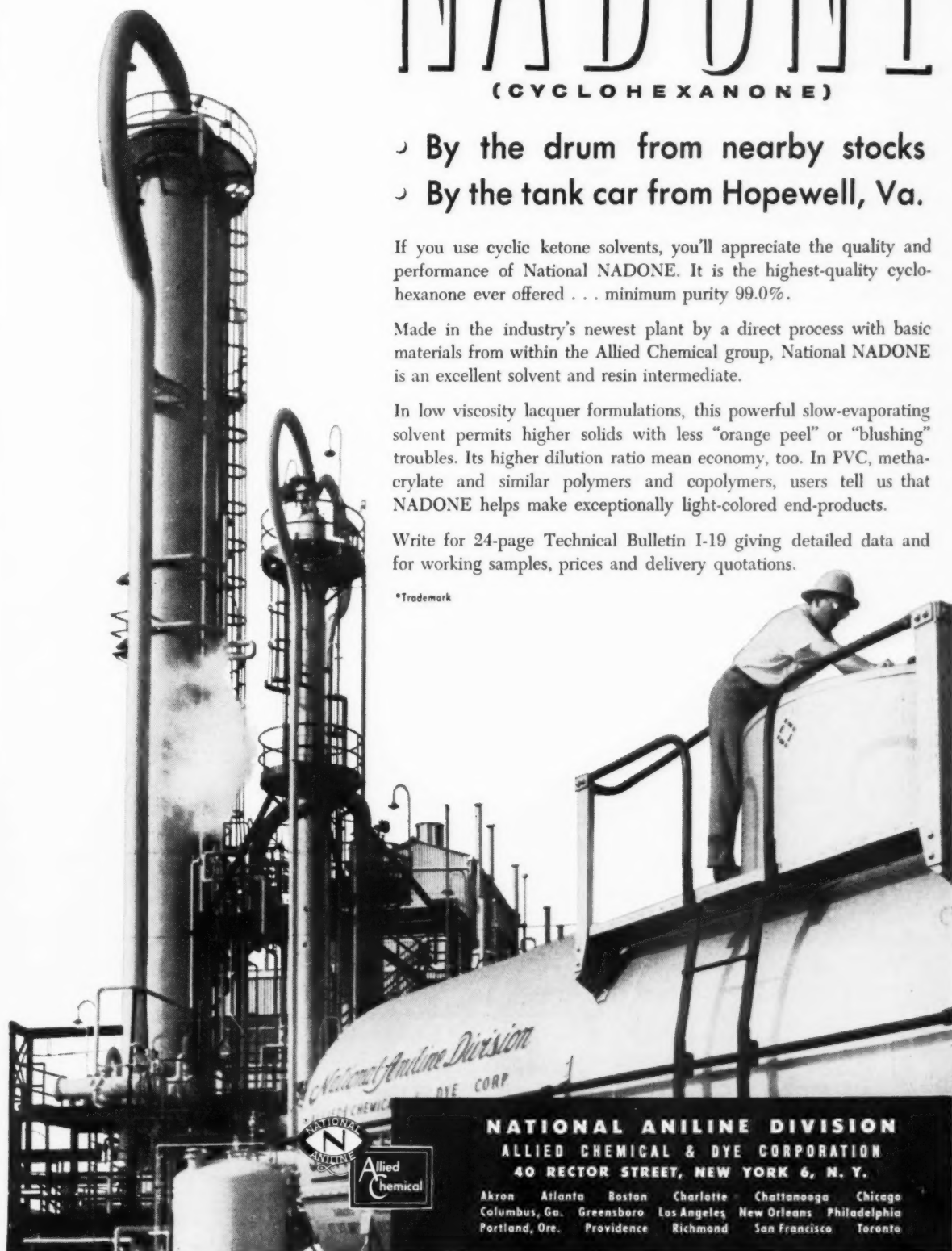
If you use cyclic ketone solvents, you'll appreciate the quality and performance of National NADONE. It is the highest-quality cyclohexanone ever offered . . . minimum purity 99.0%.

Made in the industry's newest plant by a direct process with basic materials from within the Allied Chemical group, National NADONE is an excellent solvent and resin intermediate.

In low viscosity lacquer formulations, this powerful slow-evaporating solvent permits higher solids with less "orange peel" or "blushing" troubles. Its higher dilution ratio mean economy, too. In PVC, methacrylate and similar polymers and copolymers, users tell us that NADONE helps make exceptionally light-colored end-products.

Write for 24-page Technical Bulletin I-19 giving detailed data and for working samples, prices and delivery quotations.

*Trademark



NATIONAL ANILINE DIVISION
ALLIED CHEMICAL & DYE CORPORATION
40 RECTOR STREET, NEW YORK 6, N. Y.

Akron Atlanta Boston Charlotte Chattanooga Chicago
Columbus, Ga. Greensboro Los Angeles New Orleans Philadelphia
Portland, Ore. Providence Richmond San Francisco Toronto

HUBER DISTRIBUTORS



SERVE RUBBER INDUSTRY



THE WORLD OVER

NORTH AMERICA

UNITED STATES
New England
J. M. Huber Corp.
385 Concord Ave., Belmont 78, Mass.
New York City & Vicinity
J. M. Huber Corp.
100 Park Ave., New York 17, N. Y.
Ohio & Eastern Michigan
J. M. Huber Corp.
611 West Market St., Akron, Ohio
Central Michigan
J. M. Huber Corp.
Room 1501, American National Bank Building
Kalamazoo, Mich.
Midwest
J. M. Huber Corp.
P.O. Box 309, La Grange, Ill.
Wisconsin
J. M. Huber Corp.
103 West College Ave., Appleton, Wisc.
New Jersey & Vicinity
H. M. Royal, Inc.
689 Pennington Ave., Trenton, N. J.
Southeast
J. M. Huber Corp.
Huber, Ga.
Southwest
J. M. Huber Corp.
P.O. Box 831, Borger, Texas
Pacific Coast
H. M. Royal, Inc.
4814 Loma Vista Ave.
Los Angeles 58, Calif.
CANADA
J. M. Huber Corp.
48 Neumann Parkway
Buffalo 23, N. Y.
CUBA
Mr. R. Salabarría
P.O. Box 1043, Havana

CENTRAL AMERICA

GUATEMALA
A. Mansanto & Cia.
Apartado 380, Guatemala

SOUTH AMERICA

ARGENTINA
Pablo Simko
Quintana 2430 of 8
Olivos (Bs. As.)
BRAZIL
Tennant Importacao e Exportacao Ltda.
4, Avenida Rio Branco (Salas 1407/9)
Rio De Janeiro
41, Rua Seminario S. 33/34, Sao Paulo
CHILE
Foram Chilena Ltda.
Casilla 2796, Santiago
COLOMBIA
Arnaldo Buch, Ltda.
Apartado Aereo 4074, Bogota
PERU
Tennant (Peru) S.A.
Edificio del Castillo
Av. Nicolas de Pierola 611, Lima
URUGUAY
Pedro Barford e Hijos
Paysandu 941, Montevideo
VENEZUELA
Par S.A.
P.O. Box 1834, Caracas

EUROPE

AUSTRIA—YUGOSLAVIA
H.F.J. Majunke
Postfach 50, Vienna 17/107
BELGIUM—LUXEMBURG
Sepulchre Freres & Co.
1 Quai Marcellis, Liege (Carbon Blacks)
Cie. Anversoise de Produits Chimiques
21 Rue Kipdorp, Antwerp (Clays)

DENMARK

Mr. J. Ludvigsen
Hammerensgade 6, Copenhagen

FINLAND

Max Aue
Skilnadsg 58, Helsingfors

FRANCE

Francois Vernhes
24 Rue de Clichy, Paris 9

GERMANY

Lehmann & Voss
Alsterufer 19, Hamburg 36
Paul Tiefenbacher & Co.
Ballindamm 35, Hamburg 1

HOLLAND

Gaudeket & Co.
O. Z. Voorburgwal 151, Amsterdam C

ITALY

Umberto Demeglio
94 Via Massena (412), Turin

NORWAY

Carl B. Proesch
Prinsengate 7, Oslo

PORTUGAL

Rubex, P.O. Box 314, Lisbon

SPAIN

Brandau y Cia. Ltda.
Ferroz 19, Madrid

SWEDEN

Henrik Genberg
Göthenburg—C

SWITZERLAND

Surgo Ltd., "Pfeffingherhof"
Sevogelstrasse 21, Basel

UNITED KINGDOM

J. M. Huber, Ltd.
Merrydown, Raglan Road
Reigate, Surrey, England

AFRICA

SOUTH AFRICA

Carst & Walker Pty., Ltd.
P.O. Box 5500, Johannesburg
P.O. Box 1193, Durban
P.O. Box 94, Port Elizabeth
P.O. Box 2495, Capetown

ASIA

HONG KONG & TAIWAN

China United Chemical Corp., Ltd.
P.O. Box 2045, Hong Kong
P.O. Box 781, Taipei, Taiwan

INDIA

Satish C. Anand, Plasticschemicals Company
Elphinstone Building
Churchgate St., Bombay
71 Ganesh Chandra Ave., Calcutta 13

INDONESIA

Bakrie Bros., Ltd.
5 Djalan Kunir, Djakarta, Kota

ISRAEL

Hirschberg Bros. & Co. Chemicals Ltd.
39 Wolfson St., Tel-Aviv

JAPAN

Toho Bussan Kaisha, Ltd.
No. 6, Tori-2-Chome, Nihonbashi, Chuo-ku
Tokyo

PAKISTAN

Amin Feroz & Co.
120 Serai Road, Karachi 2

PHILIPPINES

Union Trade Dist.
402-404 Uy Yet Bldg.
217 Dasmarinas St., Manila

SINGAPORE & MALAYA

Lim Teck Lee Co., Ltd.
P.O. Box 328, Singapore

THAILAND

Fra Cha Chang & Co., Ltd.
P.O. Box 310, Bangkok

TURKEY

Moiz Baruh, Y. Zara Company
P.O. Box 1811, Istanbul

AUSTRALIA

Whitney & Oettler
P.O. Box 155, Savannah, Georgia
Sub Agent: A. H. Pearce
Challis House, Martin Place, Sydney
R. A. Christian
Arnold House, 14 Queen St.
Melbourne C1

NEW ZEALAND

Gollin & Co., Pty., Ltd.
G.P.O. Box 794, Wellington C.1
P.O. Box 199, Auckland
P.O. Box 390, Christchurch



J. M. HUBER CORPORATION • 100 PARK AVENUE • NEW YORK 17, N. Y.

**CARBON BLACKS
CLAYS
RUBBER CHEMICALS**

Does America Spend Enough on Research?

SCIENTIFIC research and development are now being recognized as the major contributing factors to the industrial progress the world and the United States have enjoyed during the past decade or two. This country's total expenditure for research and development has been estimated at more than \$5 billion a year; consequently both government and industry have recently been conducting investigations and surveys to determine who is spending this money and how, and whether it represents an adequate expenditure in view of the critical importance to the defense and continued economic progress of the nation.

One of the most recent of these surveys was made by the American Institute of Management, a not-for-profit foundation making comparative studies and ratings of management for the benefit of more than 17,000 members interested in raising the standards of the management profession. The results of this study of some of the best managed companies in the country and their research efforts have been published in the form of a monograph entitled "Research and Development in the Corporation," and it is being given limited distribution by the Institute.

The AIM began by pointing out that more than one-half of today's employment in American manufacturing is in industries which owe their birth to work performed in the nation's research laboratories, and that the ratio of research-generated products to total output of industry is increasing year by year.

The Institute was forced to conclude, however, that the term "research" is used to convey markedly different meanings by officers of different corporations, even within the same industries. It followed, therefore, that little reliance could be placed upon published estimates as to the proportion of gross revenues or of net

profits before taxes to devote to research purposes, whether on an industry-wide basis or for an individual company. The common illusion that 2% or 3%, or any other figure, represents a reasonable proportion of revenues for research may actually discourage corporations with limited funds from undertaking projects which might not necessarily be costly to them and which might lead to extremely profitable results.

Another important point made in the AIM study was that despite its growth, the total of private research conducted annually by American industry is still trifling in proportion to the gross national product. And instead of a position of leadership, *the United States occupies a relatively low ranking among industrial nations whose private corporations engage in research in any meaningful sense of the term.*

The National Science Foundation released a report in mid-July on an analysis of expenditures for basic research in the United States in 1953, which showed that only 0.1% of the gross national product of \$363 billion was spent for such research. Basic research was defined as "research where the primary aim of the investigator is a fuller knowledge or understanding of the subject under study, rather than the practical application thereof." Basic research is the keystone, however, upon which applied research and development are built and is one index of the nation's scientific progress.

Apparently, research and development in this country need continued encouragement and funds if we are to maintain and improve our position with relation to the rest of the world.

R. G. Seaman

*Efficient Ultra Accelerators
for Butyl Vulcanization*

SULFADS *in nonblooming
white and light colored compounds which will not
stain or darken in service.*

.....

TELLURAC *in black or
dark colored stocks.*

STABLE WHITE OR PASTEL

Sulfur	1
Sulfads	1
Tuads	2
Captax	1

NON-BLOOMING BLACK

Sulfur	1
Tellurac	1
Tuads	2
Altax	.5

*Try these combinations in Butyl
for safe processing, rapid
vulcanization, and a high state
of cure required for good performance and aging.*



R. T. Vanderbilt Co., Inc.

230 Park Avenue,
New York 17, N. Y.

Non-Free Sulfur Curing Systems for Age Resistant Styrene-Butadiene Rubber

By L. M. HOBBS,¹ R. G. CRAIG,² C. W. BURKHART

*Engineering Research Institute and Michigan Memorial-Phoenix Project,
University of Michigan, Ann Arbor, Mich.*

The resistance to air-oven aging of styrene-butadiene rubber vulcanizates cured (a) with accelerators, (b) with dicumyl peroxide and phenyl- β -naphthylamine, and (c) with combinations of (a) and (b) showed that vulcanizates from all of these non-free sulfur curing systems had greater resistance to aging than did vulcanizates from the conventional free sulfur-accelerator combination. Vulcanizates from (c) above showed the greatest resistance to air-oven aging.

The time of resistance to scorch and thermal de-

composition of the raw unvulcanized compositions at 250° F. was found to be: 20-30, 30, and 30-40 minutes for compositions (a), (b), and (c), respectively, as compared with 60 minutes for the free sulfur-accelerator composition.

The raw material cost of the dicumyl peroxide-phenyl- β -naphthylamine system (b) is 1.8% greater, and of the other systems, (a) and (c), 5.2-5.8% greater than that of the free sulfur-accelerator system, as calculated for a composition containing 50 PHR carbon black.

THERE is a general need of improving the age resistance of rubber vulcanizates. Non-free sulfur curing systems (1-6)³ have been shown to yield vulcanizates of improved age resistance. The uncured compositions (1, 5, 6), however, have been reported to be sensitive to scorching or precuring during processing and to yield vulcanizates with poor tensile properties. Furthermore, the non-free sulfur systems comprising complex synthetic organic chemicals are more expensive than those based on elemental sulfur.

The purposes of this study were to examine several non-free sulfur curing systems with the hope of identifying combinations which could be processed at reasonable cost and which would yield vulcanizates of satisfactory physical properties and age resistance.

Three types of curing systems for styrene-butadiene 41° F. synthetic rubber (SBR-1500) were studied: (a) combinations of vulcanization accelerators; (b) dicumyl peroxide with phenyl- β -naphthylamine; (c) combinations of (a) and (b).

The results presented below show that each of the

three systems yields vulcanizates with substantially greater age resistance than the vulcanizates produced by the action of free sulfur-accelerator systems with vulcanizates from (c) being the most age resistant. Rubber compositions containing dicumyl peroxide and accelerators (b) could be held in air at 250° F. for 30-40 minutes without damage, and on curing for 30-40 minutes at 307° F. they yielded vulcanizates with physical properties essentially equivalent to those of the free-sulfur cured products. The raw materials cost of the compound containing peroxide (b) is 1.8% greater and of the other compounds 5.2-5.8% greater than the cost of the conventional free sulfur-accelerator composition.

The details of the study are presented in the following sections.

Experimental Part

Materials

SBR-1500, styrene (30)—butadiene (70) copolymer prepared at 41° F., was used as the base rubber throughout this study. The SBR-1500 was compounded with 50 PHR of medium abrasion furnace black (MAF) and with various vulcanizing agents. In the

¹Present Address: Air Reduction Co., Inc., Murray Hill, N. J.

²Present Address: Department of Dental Materials, University of Michigan.

³Numbers in parentheses refer to Bibliography items at end of this article.

TABLE 1. COMPOSITIONS OF RUBBER COMPOUNDS

Ingredient	Code Name	Parts by Weight											
		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
SBR 1500 ^a		100	100	100	100	100	100	100	100	100	100	100	100
MAF carbon black ^b		50	50	50	50	50	50	50	50	50	50	50	50
Zinc oxide		3	3	3	3			3	3	3	3	3	3
Stearic acid		1	1	1	1			1	1	1	1	1	1
Phenyl- β -naphthylamine	PBNA	1	1	1	1		1	1	1	1	1	1	1
Sulfur		1.75											
N-cyclohexyl-2-benzothiazylsulfenamide ^c	NCHBTSA	1											
Dipentamethylene-thiuramtetrasulfide ^d	DPMTTS		1										
2-Mercaptobenzothiazole ^e	MBT		1		1					0.4			
Dibenzothiazole-dimethylthiol urea ^f	DBTDMTU			1									
Tetramethyl-thiuram-disulfide ^g	TMTD			1.75	1.75			0.75					
Dicumyl peroxide-40%-calcium carbonate 60% ^h	DCP-40					1.5	2.25	3.75	3.75	3.75	3.75	3.75	3.75
Zinc dibutyl-dithiocarbamate ⁱ	ZDBDTC								1				
Diphenylguanidine ^j	DPG										0.20		
2,4-dinitrophenyl-dimethyl-dithiocarbamate ^k	DNPDMDC											0.75	
Tetrabutyl-thiuram-monosulfide ^l	TBTM												0.75

^aTexas-U.S. Chemical Co., New York, N. Y., and Goodrich-Gulf Chemicals Inc., Cleveland, O.

^bPhilblack A, Phillips Chemical Co., Akron, O.

^cSantocure, Monsanto Chemical Co., St. Louis, Mo.

^dTetron A, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

^eCaptax, R. T. Vanderbilt Co., New York

^fEl Sixty, Monsanto.

^gMethyl Tuads, Vanderbilt.

^hDiCup 40C, Hercules Powder Co., Wilmington.

ⁱButyl Zimate, Vanderbilt.

^jMonsanto.

^kSafex, Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

^lPentex, Naugatuck Chemical.

subsequent sections the particular rubber composition will be specified simply by identifying the nature and proportions of the vulcanizing agents. In the production of SBR-1500, approximately 1.25 PHR of phenyl- β -naphthylamine (PBNA) are added by the manufacturer; however, in identifying the experimental formulations PBNA will be specified only when an additional quantity of the material was used in compositions containing dicumyl peroxide.

In Table 1 the compositions of the important formulations are listed. Other compositions of the same basic types were used and will be referred to by reference to the composition type and the amount of the curing agents. Compositions I and II were chosen as reference compositions for the preparation of the corresponding vulcanizates I and II; these reference vulcanizates were used as standards for comparing the physical properties and the age resistance of experimental vulcanizates. Composition I contained a commonly used vulcanizing system consisting of free sulfur plus N-cyclohexyl-2-benzothiazyl sulfenamide (NCHBTSA) and composition II contained the sulfur-bearing accelerators dipentamethylene - thiuram - tetrasulfide (DPMTTS) and 2-mercaptobenzothiazole (MBT). This latter curing system has received considerable attention by Ossefort, Shaw, and Bergstrom (6) as a non-free sulfur curing system which yields a vulcanizate with excellent age resistance.

Preparation of Vulcanizates

All compositions were prepared on a three-by eight-inch two-roll mill using the ASTM⁴ mixing procedure for SBR rubber (D 15-55T). Since 200 grams of ma-

terial represented the maximum amount that could be easily handled on this equipment, special care during compounding was required in order that separate batches of the same composition yielded vulcanizates having the same physical properties.

The rubber compounds were placed in a single-cavity (ASTM specification D 15-55) six- by six- by 0.075-inch chromium plated steel compression mold, cured for 30 minutes at 2200 psi. and 307° F., and the cured sheets were quenched in cold water.

The same lot of SBR-1500 was used throughout this research with the exception of a few aging experiments which were carried out on a second lot. The curing systems consisting of free sulfur and accelerator and combinations of sulfur-bearing accelerators yielded vulcanizates having comparable physical properties with each lot of SBR-1500. In curing systems containing DCP-40, however, it was necessary to increase the amount of DCP-40 by 0.25-PHR for the second lot in order to obtain comparable physical properties with the first. In order to avoid confusion, the amount of DCP-40 recorded has been on the basis of the first lot.

Physical Measurements

Tensile and tear specimens were cut from the test sheets by ASTM tensile die C (ASTM D 412-51T) and ASTM tear die C (ASTM D 624-54), respectively. The tensile and tear measurements were made on an automatic recording tensile testing machine at 77° F. and 50% relative humidity. The physical properties of the vulcanizates reported in succeeding tables are average values of four or more determinations.

⁴American Society for Testing Materials, 1916 Race St., Philadelphia, Pa.



Robert G. Craig



Clarence W. Burkhart



Lindsey M. Hobbs

The Authors

Lindsey M. Hobbs, director, Michigan Memorial Phoenix Project on Elastomers, University of Michigan, until July 1, 1957, is now assistant director of chemical research, Air Reduction Co., Murray Hill, N. J. He received his B.S. in chemistry at The Citadel in 1931, his M.S. from the University of Alabama in 1932, and his Ph.D. from the University of Chicago in 1938.

Dr. Hobbs was a post-doctorate Fellow at the University of Chicago until 1939; an instructor in physical chemistry at the University of Alabama until 1941 and a Fellow until 1942; a senior at Mellon Institute from 1942 until 1946; and a chemist and then group leader with the Standard Oil Co. of Indiana until he took charge of the Michigan Memorial Phoenix Project on Elastomers in 1952.

He is a member of the American Chemical Society and Sigma Xi.

Robert G. Craig, now assistant professor of dentistry materials, University of Michigan, was an associate research engineer with the Engineering Research Institute between 1955 and 1957. He obtained his B.S. in chemistry in 1944, his M.S. in 1951, and his Ph.D. in 1954, all from

the University of Michigan.

He worked as a research chemist for Linde Air Products Co. from 1944 until 1950 and held a similar position with Texas Co. from 1954 to 1955.

Dr. Craig is a member of the American Chemical Society, Sigma Xi, Phi Kappa Phi, and Phi Lambda Upsilon.

Clarence W. Burkhart, research assistant at the University of Michigan since his retirement from The B. F. Goodrich Co. in 1955, received his B.A. degree from Butler University in 1914, did graduate work at the University of Illinois in 1914 and 1915, and obtained a M.S. degree from the University of Missouri in 1922.

Mr. Burkhart has had a long and varied experience with Victor Chemical Works, International Nickel Co., and Pennsalt Mfg. Co., and then worked for the Firestone Tire & Rubber Co. from 1944 to 1949, and The B. F. Goodrich Co. from 1949 until 1955.

He has been a member of the American Chemical Society and the Akron Rubber Group and is an emeritus Fellow of the American Institute of Chemists.

Hardness values were determined according to ASTM Method D 676-55T.

The scorch characteristics of the uncured compositions were determined by use of a shearing disk viscometer at 250° F., according to ASTM Method D 1077-55T. Duplicate experiments were made on all compounds evaluated.

The scorch test, ASTM D 1077-55T, was not entirely satisfactory for the compositions containing dicumyl peroxide since the peroxide tends to decompose without forming cross-links at temperatures approaching 250° F. Another procedure was devised to indicate the processing behavior of uncured compositions containing dicumyl peroxide in the temperature range of 230-250° F. The uncured compound was

sheeted on the mill at about 0.080-inch thickness, and four- by four-inch pads were cut out of the sheets. The pads were placed into a circulating air oven at a temperature in the range of 230-250° F. for periods up to three hours. After this heating period the pads were cured by the procedure described above for 30 minutes at 307° F. and 2200 psi. The tensile properties of the cured sheets could then be used as the basis for estimating the extent of the decomposition of the peroxide due to heating of the uncured compositions.

A mechanical convection oven was used for the aging experiments. The temperature variation of the oven at 212° F. was within $\pm 1^\circ$ F. The conditions for most of the aging experiments were 72 hours at 212° F. The aging properties of selected compositions, however,

TABLE 2. PHYSICAL PROPERTIES OF SELECTED COMPOSITIONS AND VULCANIZATES

Com- position Num- ber	Curing System ^a	Tensile, Psi.		Elongation, %		Stress at 300% E., Psi.		Tear, Lbs./In.		Durometer Hardness		Mooney Scorch, Min.	
		Un- aged	Aged ^b	Un- aged	Aged ^b	Un- aged	Aged ^b	Un- aged	Aged ^b	Un- aged	Aged ^b	t ₅ ^c	t ₁₀ ^c
I	1.75 Sulfur + 1 NCHBTSA	2450	2550	480	260	2150	260	170	68	74	61	67	
II	1 DPMTTS + 1 MBT	2100	2400	440	380	1340	1890	280	210	65	67	7	8
III	1.75 TMTD + 1 DBTDMTU	2180	2680	650	590	950	1290	290	280	65	65	19	22
IV	1.75 TMTD + 1 MBT	2360	2720	610	550	1020	1440	280	270	66	66	23	28
V	1.5 DCP-40	2220	1970	420	400	1550	1450	220	220	65	66		
VI	2.25 DCP-40 + 1 PBNA	2280	2170	450	440	1730	1680	230	260	65	65	54	70
VII	3.75 DCP-40 + 0.75 TMTD + 1 PBNA	2330	2570	550	560	1170	1290	210	210	62	66	26	33
VIII	3.75 DCP-40 + 1 ZDBDTC + 1 PBNA	2540	2630	470	450	1480	1610	180	200	65	66	40	58
IX	3.75 DCP-40 + 0.4 MBT + 1 PBNA	2280	2200	310	310	2090	2010	110	110	68	69		
X	3.75 DCP-40 + 0.2 DPG + 1 PBNA	2360	2250	330	320	2060	1980	160	160	69	70		
XI	3.75 DCP-40 + 0.75 DNPDMTDC + 1 PBNA	1360	1720	570	550	690	890	210	270	62	66		
XII	3.75 DCP-40 + 0.75 TBTM + 1 PBNA	2460	2480	480	460	1480	1500	190	210	65	67		

^aThe rubber contained 1.25 PHR. Only concentration of additional PBNA is shown in formulations.

^bSamples were aged in an air oven at 212° F. for 72 hours.

^ct₅ and t₁₀ represent the number of minutes required for a five- and ten-unit rise over the minimum.

were determined for periods of 32 days at 212° F., seven days at 250° F., and for 12 hours at 300° F.

Since it had been shown by Fackler and Rugg (7) that migration of compounds such as antioxidants can take place between specimens during air-oven aging experiments, only similar types of vulcanizates were aged at a given time.

Presentation of Results

Accelerator Vulcanizing Systems

As mentioned previously, combinations of the accelerators (which are frequently used with free sulfur) were employed as the total vulcanizing system in the absence of added free sulfur. Three systems were studied:

- 1 PHR Dipentamethylene-thiuram-tetrasulfide (DPMTTS)
1 PHR 2-Mercaptobenzothiazole (MBT)
- 1 PHR Dibenzothiazole-dimethylthiol urea (DBTDMTU)
1-3 PHR Tetramethyl-thiuram-disulfide, and (TMTD)
- 1 PHR 2-Mercaptobenzothiazole
1-2 PHR Tetramethyl-thiuram-disulfide

Also, as previously mentioned, the first composition (a) was selected as a reference standard (reference composition II).

The ultimate tensile and elongation values of the vulcanizates prepared from the second and third compositions, (b) and (c), are plotted in Figure 1, a and b. The values of the physical properties after air-oven aging are also shown on the graph. It may be seen from these curves that the optimum compositions are approximately:

- 1.75 PHR TMTD
1 PHR DBTDMTU, and
- 1.75 PHR TMTD
1 PHR MBT

The physical properties of vulcanizates prepared from the two optimum compositions, III and IV, as well as those of the reference vulcanizates I and II, are listed in Table 2. Vulcanizates from compositions III and IV possessed lower values of tensile strength, stress at 300% elongation (300% modulus), and hardness, about the same tear resistance, and considerably higher elongation values than reference vulcanizate I which was cured with sulfur plus NCHBTSA. Vulcanizates III and IV had physical properties which were generally comparable to the non-free sulfur cured reference standard II, although the elongation values of vulcanizates III and IV were somewhat higher.

When the physical properties of the aged samples in Table 2 are compared, however, it is apparent that vulcanizates from compositions III and IV were somewhat more resistant to aging than the reference vulcanizate II, and they were substantially more resistant than reference vulcanizate I.

The scorch resistance of compositions III and IV and reference compositions I and II, as measured by a shearing disk viscometer, are also reported in Table 2. Compositions III and IV were considerably more scorch resistant than reference composition II, but less than reference composition I.

Vulcanizates III and IV exhibited a tendency to bloom; the blooming properties of the former were the more pronounced. It was learned (8) that the addition of low molecular weight polyethylene waxes to rubber compositions might hinder or completely prevent blooming. A few vulcanizates of the composition III (TMTD with DBTDMTU) were prepared with 2 PHR of the polyethylene wax. These products had slightly lower tensile strengths and slightly higher % elongations and no bloom. While this study was limited to a few mixes of only one type of composition, the results do offer encouragement for the possibility of better control of bloom.

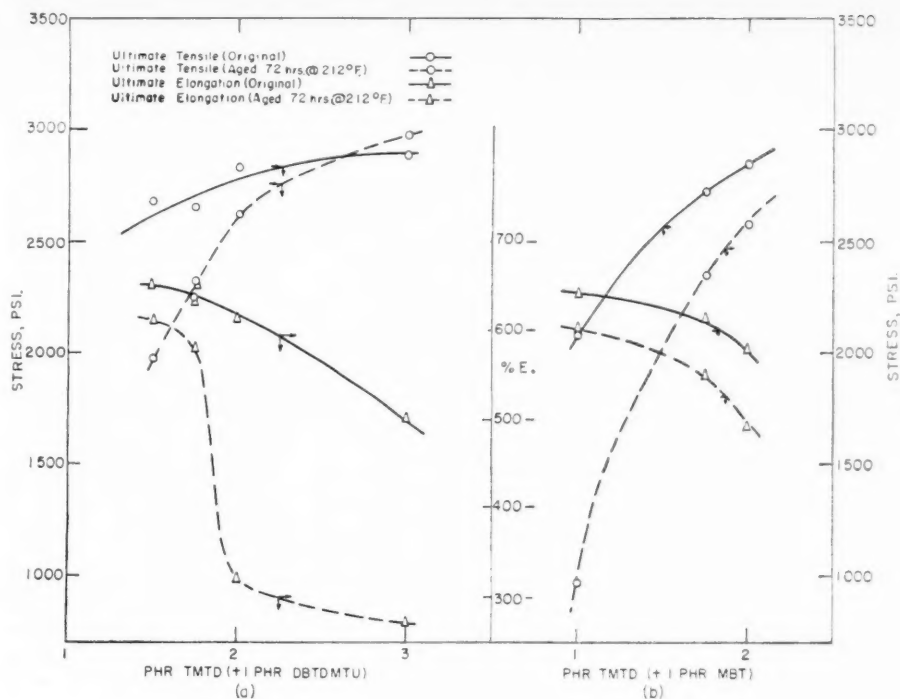
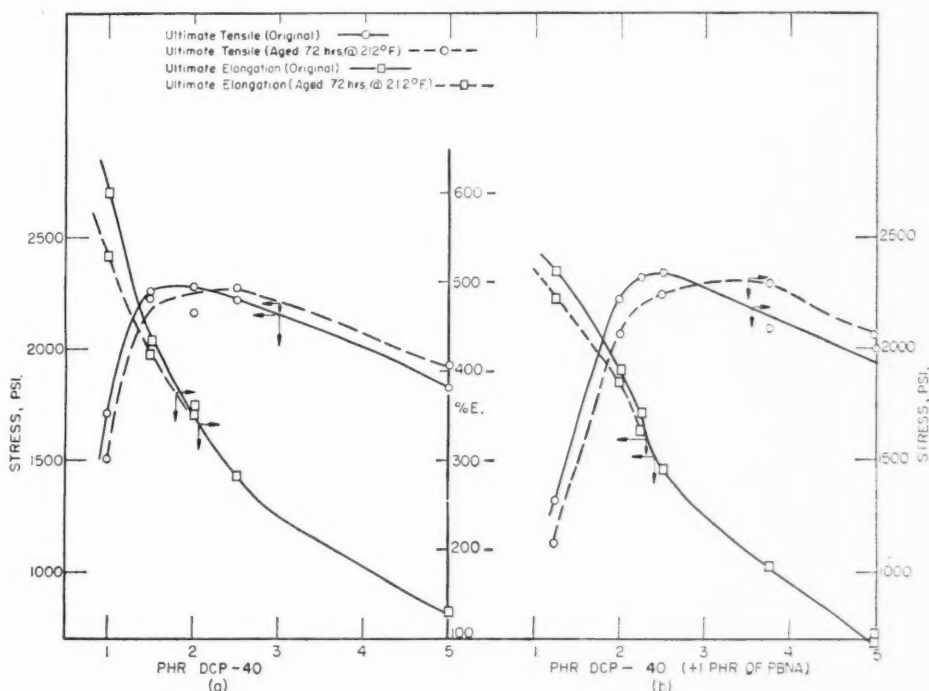


Fig. 1. Original and aged tensile and elongation properties of SBR vulcanizates cured with TMTD and DBTDMTU (a) and TMTD and MBT (b)

Fig. 2. Original and aged tensile and elongation properties of SBR vulcanizates; cured with dicumyl peroxide (a) and dicumyl peroxide plus PBNA (b)



Dicumyl Peroxide Vulcanizing System

The improved aging qualities of vulcanizates produced in the absence of added free sulfur, such as presented in the preceding section, have increased interest in curing systems containing no sulfur at all.

Much of the early work on various types of peroxides (1, 4, 9) did not indicate much promise for commercial applications. During the early stages of the

present investigation, however, the commercial availability of dicumyl peroxide (10) was announced, and the first information indicated that it possessed promising qualities for rubber vulcanization. Thus it was of considerable interest to examine this material. Also, during the course of this work successful vulcanizations of *Hevea* (NR) and nitrile rubbers (NBR) with dicumyl peroxide were reported (5, 11).

TABLE 3. STABILITY OF COMPOUNDED RUBBER TO HEATING IN AIR^a

Com- position Number	Curing System	Temp.		Tensile, Psi.					Elongation, %					Stress at 300% E., Psi.					Durometer Hardness				
				Hours					Hours					Hours					Hours				
		0	1/2	1	2	3	0	1/2	1	2	3	0	1/2	1	2	3	0	1/2	1	2	3		
VI	2.25 DCP-40 + 1 PBNA	250	2380	2300	1770	1010	..	490	490	610	680	..	1240	1190	710	380	..	65	65	62	60	..	
	2.25 DCP-40 + 1 PBNA	240	2270	2230	2140	1610	1670	400	420	460	510	510	1760	1570	1340	870	950	67	66	65	63	63	
	2.25 DCP-40 + 1 PBNA	230	2130	2120	2080	1500	1510	500	520	560	590	600	1280	1130	950	780	740	63	63	63	63	62	
III	1.75 TMTD + 1 DBTDMTU	230	2150	2520	2340	2120	..	650	640	650	640	..	1300	1450	1400	1400	..	65	65	65	69	..	
IV	1.75 TMTD + 1 MBT	250	2300	2480	2400	2110	..	500	580	580	570	..	1430	1580	1620	1570	..	65	65	65	67	..	
	3.75 DCP-40 + 0.75 TMTD + 1 PBNA	250	2350	2310	2060	1980	..	510	550	580	500	..	1410	1250	1200	1170	..	65	65	65	69	..	

^aThe compounded rubbers were heated in air at the designated temperatures and times after which the compounds were cured for 30 minutes at 307° F., and the physical properties of the resulting vulcanizates were measured.

^aThe compounded rubbers were heated in air at the designated temperatures and times after which the compounds were cured for 30 minutes at 307° F., and the physical properties of the resulting vulcanizates were measured.

The ultimate tensile and elongation values of vulcanizates cured with various amounts of dicumyl peroxide are shown in Figure 2, a and b.

The vulcanizates used to obtain the curve in Figure 2a were prepared from rubber compounds which contained only the PBNA originally present in the SBR-1500 (approximately 1.25 PHR), while those in Figure 2b contained one additional PHR of PBNA. It should be noted that the concentration of DCP-40 corresponding to the maximum tensile value shifted from approximately 1.5 to 2.25 PHR of DCP-40 by the addition of one PHR of PBNA. Thus it was apparent that portions of the amine antioxidant and the dicumyl peroxide reacted.

The physical properties of the optimum vulcanizates V and VI cured with DCP-40 are recorded in Table 2. These vulcanizates had somewhat low values of tensile strength, % elongation, stress at 300 % elongation, and tear resistance in comparison with those of the standard NCHBTSA-sulfur cured vulcanizates; while the hardness values were comparable. These peroxide cured vulcanizates also had lower % tear resistance values than the DPMTTT-MBT reference vulcanizate II, but otherwise the original physical properties were similar. In general, the tensile properties of the DCP-40 cured vulcanizates changes less on aging than did those of the reference vulcanizates I and II.

The Mooney scorch resistance of composition VI containing 2.25 PHR of DCP-40 appeared to be comparable to that of the reference composition I which contained free sulfur and NCHBTSA. This conventional scorch test, however, was not entirely meaningful for the peroxide compositions since some peroxide decomposed without causing vulcanization during the test (12). Therefore the supplementary test described in the Experimental Part was used which involved heating sheets of the compounded rubber, as obtained directly from the mill, in a circulating air-oven for periods up to three hours at temperatures from 230 to 250° F. followed by curing at 307° F. for 30 minutes, and finally determination of the physical properties. The physical properties of vulcanizates from compositions heated at 230, 240, and 250° F. and containing originally 2.25 PHR of DCP-40 and one additional PHR of PBNA are summarized in Table 3. It may be seen that the compositions withstood heating in air for about 30-40 minutes at 250° F. and somewhat longer periods at the lower temperatures before changes in the physical properties of the corresponding vulcanizates were substantial. Thus the safe processing time is judged to be approximately 30-40 minutes, rather than 54 minutes as measured by the Mooney scorch test.

Since the supplementary test seemed more realistic than the Mooney scorch test for evaluating the processing safety of rubber compounds containing dicumyl peroxide, it was of interest to determine the safe processing times of compositions III and IV by this heating procedure. Table 3 contains the results of these experiments on compounds containing accelerator combinations. These data indicate that periods in which the raw compositions can be held at 250° F. without causing substantial changes in the tensile properties of the final vulcanizates are in the range of 20-30 minutes. The

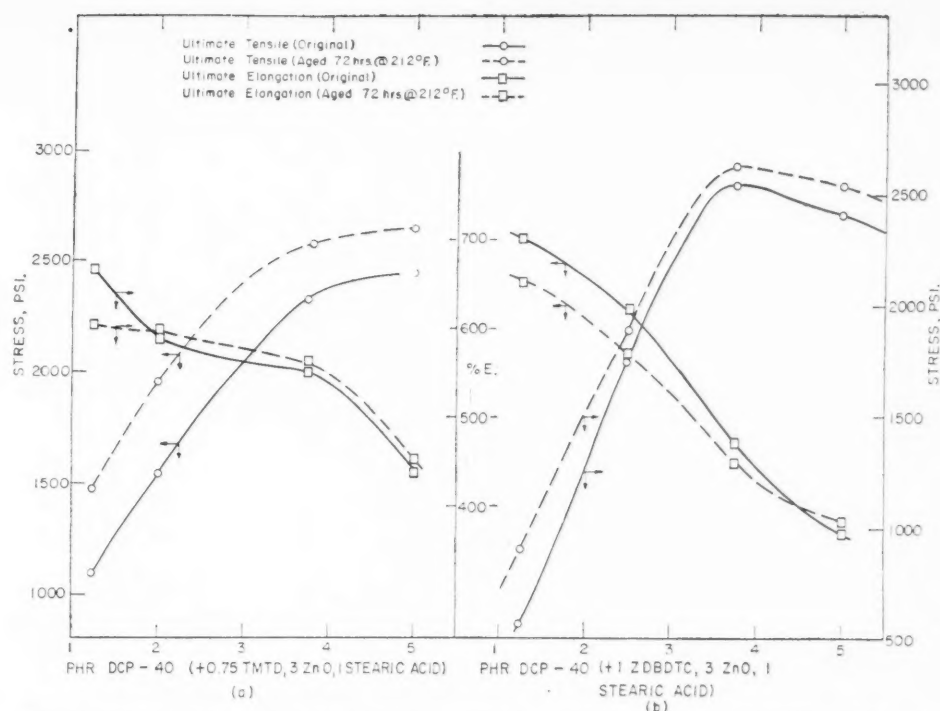


Fig. 3. Original and aged tensile and elongation properties of SBR vulcanizates cured with dicumyl peroxide and TMTD (a) and dicumyl peroxide and ZDBDTC (b)

heating of the compositions for periods of 30-60 minutes resulted in products which, after curing, possessed higher tensile strength than those which had not been preheated. It is interesting that after heating the raw composition III for two hours at 250° F., the formulation could still be compression molded at 307° F. to yield a sound sheet. These results emphasize the arbitrariness associated with the rating of general processing stability from specific laboratory tests.

Dicumyl Peroxide-Sulfur-Bearing Accelerator Vulcanizing Systems

The third type of vulcanizing system comprised the use of accelerators in combination with dicumyl peroxide and PBNA. They included the compounds in the following groups:

- (1) Zinc dibutyl-dithiocarbamate (ZDBDTC)
Tetramethyl-thiuram-disulfide (TMTD)
Tetrabutyl-thiuram-monosulfide (TBTM),
- (2) 2-Mercaptobenzothiazole (MBT)
Diphenylguanidine (DPG), and
- (3) 2,4-Dinitrophenyl-dimethyl-dithiocarbamate (DNPDMDTC)

Vulcanizates cured with combinations of DCP-40 and members of the first group generally possessed the highest values of physical properties; those formed from the use of the second group of accelerators appeared to have some less desirable properties; and those prepared by use of DCP-40 and the compound of the third group had the least desirable physical properties.

The ultimate tensile and elongation values for vul-

canizates cured with various amounts of DCP-40 with TMTD, and with ZDBDTC are shown in Figure 3, a and b. Typical sets of physical properties for the vulcanizates cured with combinations of DCP-40 and members of the three groups mentioned above are listed in Table 2 (composition numbers VII-XII).

It was found necessary to add one PHR of stearic acid and three PHR of zinc oxide to the compositions containing DCP-40 plus TMTD or ZDBDTC as curing agents in order to obtain vulcanizates with good physical properties. The optimum composition VII contained 3.75 PHR of DCP-40, 0.75 PHR of TMTD, one PHR of PBNA, one PHR of stearic acid, and three PHR of zinc oxide. When the properties of the vulcanizate from this compound are compared with those of the optimum vulcanizate VI, containing DC-40 as the only curing agent (Table 2), it is apparent that the use of TMTD with DCP-40 has caused some increase in tensile strength and a large increase in elongation, with little effect on the other physical properties and the age resistance.

Similar and somewhat more pronounced changes resulted from the use of DCP-40 with ZDBDTC and PBNA. The optimum composition VIII as determined from Figure 3b, was 3.75 PHR of DCP-40, one PHR of ZDBDTC, one PHR of stearic acid, and three PHR of zinc oxide, and it can be seen in Table 2 that the resulting vulcanizate had higher tensile and elongation values than the DCP-40 cured vulcanizate, with equally good resistance to aging.

The values of the physical properties of the unaged vulcanizates of composition VIII are therefore similar,

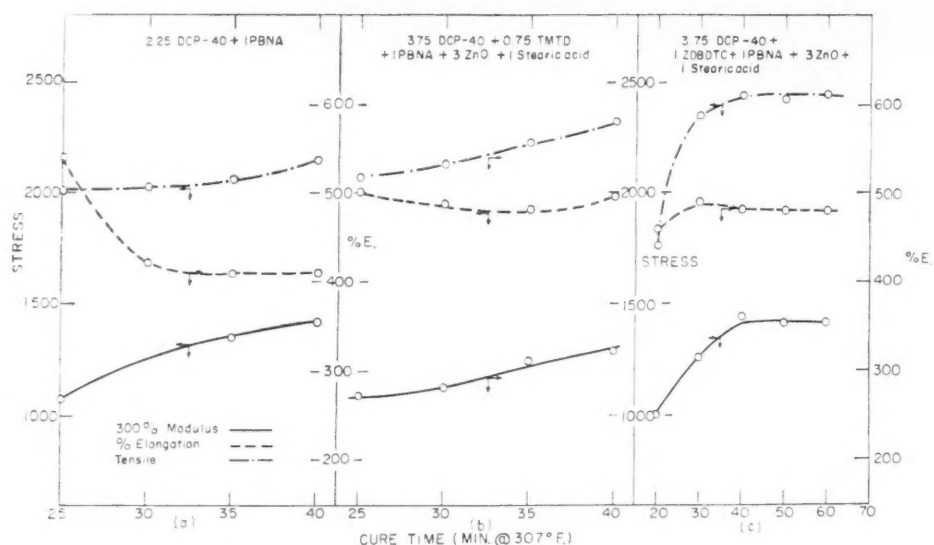


Fig. 4. Effect of curing time on tensile strength, 300% modulus, and elongation of SBR vulcanizates cured with systems containing dicumyl peroxide

but not identical with those of the vulcanizates from the free sulfur-accelerator combination. It should be noted, however, that the concentration of DCP-40 required to yield a product possessing maximum tensile strength is greater than the concentration necessary to give the product with maximum tear strength.

The tensile values for the aged vulcanizates in Figure 3, a and b, were higher than those of the comparable unaged samples; the effect was the more pronounced for the products formed in the presence of DCP-40 and TMTD. The reasons for this effect are not completely clear, but must be due at least in part to additional curing during the aging process. This effect will be discussed further in the following section.

Mooney scorch values for compositions VII and VIII were 26 and 40 minutes, respectively; and the time of heating of composition VII, at 250° F., which did not produce changes in the physical properties of the vulcanizate was 30 minutes.

Effect of Curing Time on Dicumyl Peroxide Systems

As anticipated above, it was of interest to examine the effect of curing time at 307° F. on the unaged physical properties of vulcanizates cured with dicumyl peroxide alone and in combination with accelerators.

In Figure 4, a, b, and c, variations of tensile properties with curing time are shown for vulcanizates cured with DCP-40 and with combinations of DCP-40 and TMTD or ZDBDTC. Figure 4, a and c, show that the tensile properties of the vulcanizates have reached or are rapidly approaching limiting values at curing times of 30 to 35 minutes at 307° F. The tensile properties of the DCP-40-TMTD cured samples (Figure 4b), however, appear to be rising at the 40-minute point. It seems likely, therefore, that postcuring during aging may account, at least in part, for the large increase in tensile strength after air-oven aging shown in Figure 3a.

Aging of Selected Vulcanizates at Various Temperatures

The vulcanizates III to VIII were resistant to air-oven aging at 212° F. during 72 hours. To gain further information about their age resistance under more stringent conditions, vulcanized test specimens were subjected to air-oven aging at 212° F. for periods up to 32 days, at 250° F. for periods up to 15 days, and at 300° F. for periods up to 12 hours. The effects of extended aging at 212° F. on ultimate elongation, tensile, and stress at 300% elongation are summarized in Figures 5, 6, and 7. Figures 8 and 9 show the effect of air-oven aging at 250 and 300° F. on the ultimate elongation of the various vulcanizates. A brief summary of these data is reported in Table 4.

AGING STUDIES AT 212° F. On inspection of the curves shown in Figures 5, 6, and 7, it can be seen that the % elongation of the vulcanizates varied more regularly with time of aging than did the stress at 300% elongation or the ultimate tensile strength. Thus, for purposes of discussion, attention may be concentrated on Figure 5.

It is interesting that the vulcanizates from the peroxide containing compositions, VI, VII, and VIII, showed the greatest resistance to change in % elongation throughout the 30-day period at 212° F. Vulcanizates III and IV, from the sulfur-bearing accelerator combinations, however, showed equally good resistance after the first 10 days.

Vulcanizate V, produced by the action of 1.5 PHR DCP-40 (without additional PBNA), showed relatively poor resistance to aging, but vulcanizate VI, formed from 2.25 PHR of DCP-40, with one additional PHR of PBNA, showed excellent resistance. The age resistance of the vulcanizate formed from three PHR DCP-40 with two additional PHR of PBNA (not shown on the graph) was somewhat greater than that of vul-

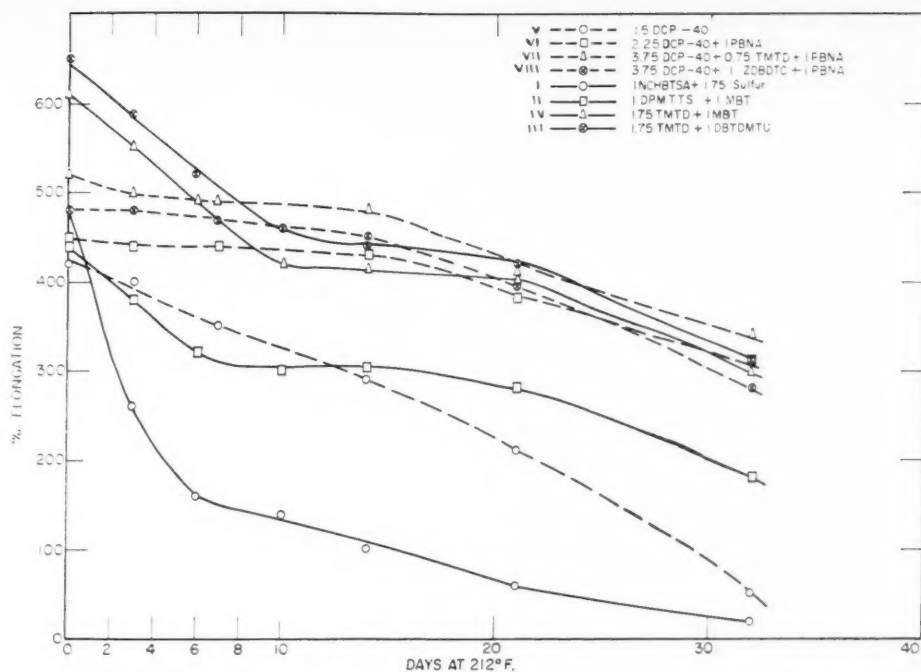


Fig. 5. Effect of extended air-oven aging at 212° F. on the elongation of SBR vulcanizates²

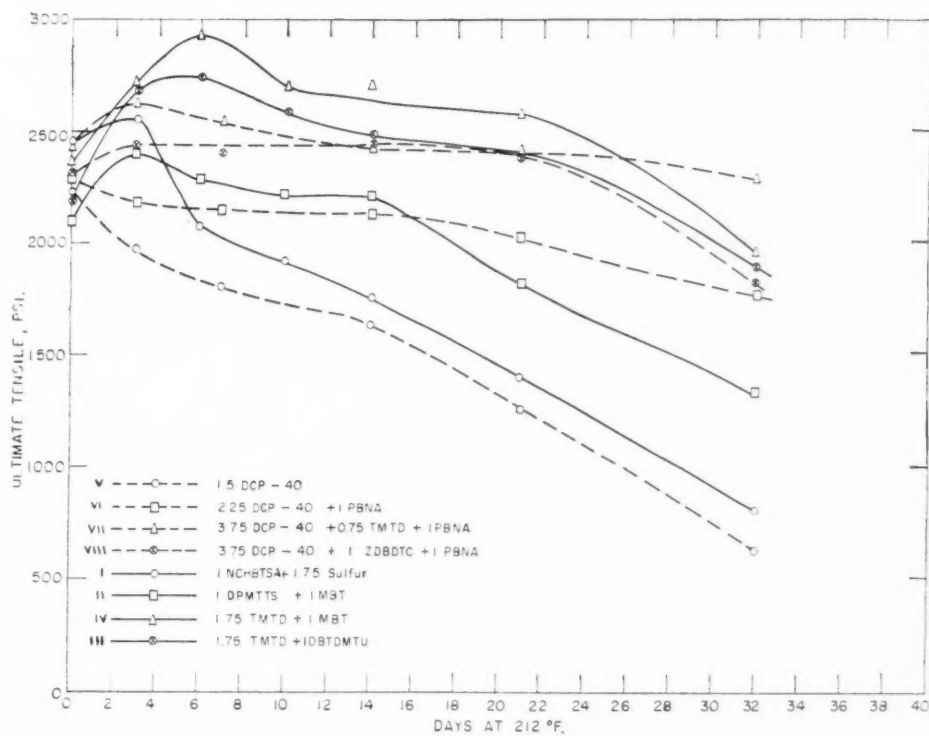


Fig. 6. Effect of extended air-oven aging at 212° F. on the tensile strength properties of SBR vulcanizates

² Roman numerals at left of legends in Figures 5-9 are the Composition Numbers (Table 2).

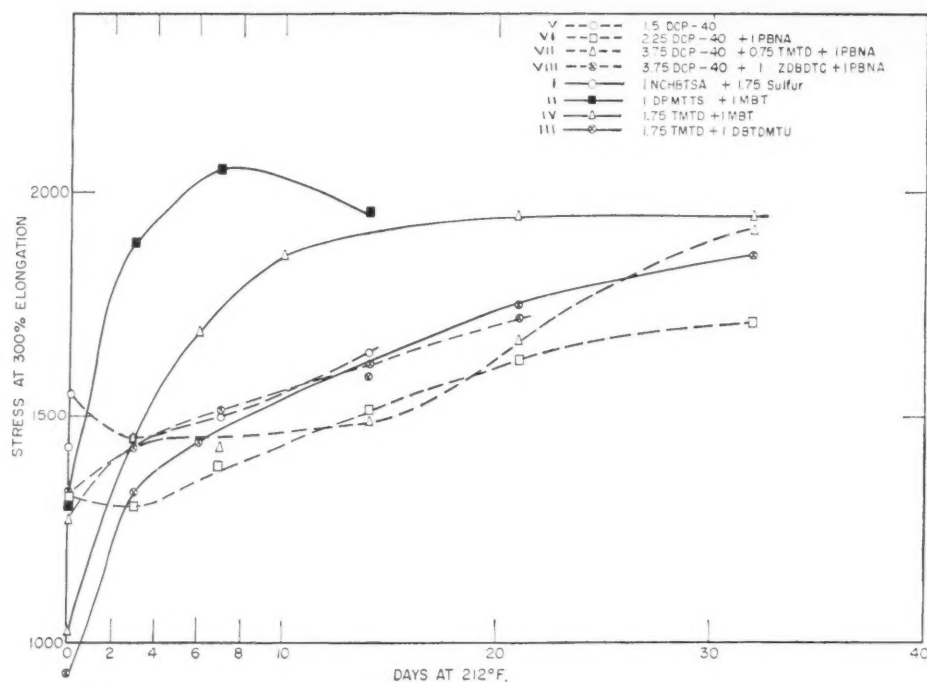


Fig. 7. Effect of extended air-oven aging on the stress at 300% elongation of SBR vulcanizates

canizate VI; however, the product from 3.75 PHR DCP-40 with three additional PHR of PBNA (not shown on the graph) gave no further improvement in age resistance.

AGING STUDIES AT 250° F. The % elongation values of the selected vulcanizates after air-oven aging for various times at 250° F. are shown in Figure 8, and the tensile, elongation, stress at 300% elongation, and hardness after aging for seven days at 250° F. are reported in Table 4. The data indicate that 250° F. represents severe aging conditions. From results not shown in Table 4, it was apparent that the % elongation of all of the compositions would be essentially zero after eleven days in air at 250° F.

The vulcanizates VII and VIII (cured with DCP-40 plus TMTD or ZBDTC and including additional PBNA) had the greatest resistance to aging at 250° F. The order of decreasing age resistance of the remaining vulcanizates was: (1) accelerator cured reference vulcanizate II; (2) dicumyl peroxide cured vulcanizate VI; and (3) the sulfur plus accelerator cured standard vulcanizate I.

AGING STUDIES AT 300° F. The curves in Figure 9 represent the change in elongation with the time of air-oven aging at 300° F.; while Table 4 lists the tensile, elongation, stress at 300% elongation, and hardness after aging 12 hours at 300° F.

Again, the vulcanizates cured with dicumyl peroxide plus accelerator combinations, VII and VIII, exhibited the greatest age and/or temperature resistance. These vulcanizates showed little change in elongation until after nine to 12 hours in air at 300° F. Beyond that point the elongation decreased regularly to a value of approximately 150% at 20 hours.

Raw Materials Costs of Vulcanization Systems

In Table 5 the relative costs of the compositions I -VIII (excluding V) including the indicated vulcanizate agents and 50 PHR MAF carbon black are listed. It may be seen that raw materials costs of vulcanizate VI is 1.8% greater, and the other compositions are 5.2—5.8% greater than the cost of the sulfur-accelerator system.

TABLE 5. COST OF MATERIALS FOR SELECTED COMPOSITIONS

Com- position Number	Curing System	Materials Cost,* \$/100 Lbs. Com- pounded Rubber	% Cost Increase over Com- position I
I	1.75 Sulfur + 1 NCHBTSA	19.05	....
II	1 DPM TTS + 1 MBT	20.05	5.2
III	1.75 TMTD + 1 DBTDMTU	20.16	5.8
IV	1.75 TMTD + 1 MBT	20.04	5.2
VI	2.25 DCP-40 + 1 PBNA	19.40	1.8
VII	3.75 DCP-40 + 0.75 TMTD + 1 PBNA	20.04	5.2
VIII	3.75 DCP-40 + 1 ZBDTC + 1 PBNA	20.15	5.8

*The values listed were estimated from market prices listed in *Rubber Age* (N. Y.), 79, 870 (1956).

TABLE 6. SUMMARY OF FINDINGS

Composition		Vulcanizates					
				Cross-Links		Safe Processing Time Min. at 250° F.	Relative Materials Cost
No.	Type	Tensile Properties	Bloom	Age Resistance	Type		
I	Free sulfur + NCHBTSA	Excellent	No	Poor	-C-S ₂ -C-	60	100.0
II-IV	Accelerator combinations	Fair	Yes	Good	-C-S-S-C-	20-30	105.2-105.8
VI	DCP-40 + PBNA	Good	No	Very good	-C-S-C-	30	101.8
VIII	DCP-40 + ZBBDTC + PBNA	Excellent	No	Excellent	-C-C- ?	40	105.8

Discussion of Results

The results of this study are summarized in a qualitative fashion in Table 6 and are briefly discussed in the following paragraphs.

Physical Properties of Vulcanizates

It has been seen that physical properties of the unaged vulcanizates prepared by use of the peroxide-accelerator-PBNA system are essentially equivalent, though not identical, to those of the products cured with the free sulfur-accelerator system. Vulcanizates prepared by the action of dicumyl peroxide without accelerators, and vulcanizates produced by the accelerators combinations possessed somewhat lower tensile properties. However, heating of the uncured accelerator compositions for 30 minutes at 250° F. followed by compression molding at 307° F. for 30 minutes yielded sheets with high tensile strengths. The vulcanizates which had been cured with accelerator combinations showed a tendency to bloom. The presence of a small amount of polyethylene wax eliminated bloom in the one case tried. Vulcanizates from the peroxide systems showed no bloom.

Age Resistance of Vulcanizates

The age resistance of the vulcanizates produced from all of the non-free sulfur curing systems was substantially greater than those from the free sulfur-accelerator combination. The vulcanizates produced by the action of dicumyl peroxide in combination with accelerators were the most resistant to air-oven aging.

By reference to Table 6, a rough parallelism may be noted between the age resistance of vulcanizates and the strength of the probable cross-links, as listed by Dogadkin and Torasova (13). On that basis it would appear that C-C cross-links should yield the strongest and most age resistant rubber. Then the question arises regarding the contribution of the accelerators (which contain sulfur and nitrogen) to the dicumyl peroxide vulcanization. Three possible functions of the sulfur-nitrogen bearing accelerators to the peroxide vulcanization are suggested: (1) the accelerators induce the decomposition of the peroxide, allowing the process to take place at a lower activation energy and resulting in a more even distribution of cross-links; (2) the decomposition products of the sulfur-nitrogen bearing accel-

erators function as antioxidants; and (3) the accelerators act as dispersing agents for the peroxide in the rubber.

While the results of this study do not afford a decision regarding the relative merits of these suggestions, they do emphasize that further study of dicumyl peroxide vulcanization systems should include attention to other reducing and dispersing agents.

Processing Stability of Uncured Compositions

The results listed in Table 6 show that compounds containing the conventional free sulfur-accelerator combination remain the most resistant to precuring or decomposition during processing. Compounds with the peroxide combinations are stable in air for 30-40 minutes at 250° F. and for longer periods at lower temperatures. The accelerator compositions gave scorch values of 20-30 minutes. The heating of the uncured accelerator formulations from 0.5 to 2.0 hours at 250° F., however, did not prevent curing by compression molding at 307° F.

Relative Costs of Raw Materials

The raw materials costs for compositions containing 50 parts of carbon black per hundred parts of rubber and the specified vulcanizing agents are surprisingly similar. The DCP-40 + PBNA composition is 1.8% greater and the others are 5.2-5.8% greater than the cost of the free sulfur-accelerator combination.

Thus it is concluded that vulcanization systems for SBR based on dicumyl peroxide in combination with accelerators and phenyl-β-naphthylamine yield vulcanizates with satisfactory physical properties and excellent aging qualities, but they are somewhat more expensive and are less stable to processing than the conventional free-sulfur accelerator curing systems.

Acknowledgments

We express our appreciation to the Ordnance Corps, Department of the Army, for financial support of this work, to A. C. Hanson, R. Shaw, and Z. T. Ossefort, of the Rock Island Arsenal Laboratories, for their help and suggestions, and to J. E. Marberry and R. N. Wetterholt for assistance in the experimental work.

(Continued on page 744)

WADC Evaluation Of Experimental Polymers¹

By W. R. GRIFFIN

Wright Air Development Center, Wright-Patterson Air Force Base, Ohio

More and more requirements for elastomers capable of -100 to $+600^{\circ}$ F. service in a variety of fluids are becoming apparent.

Fluoroacrylate rubbers, fluoroalkyl vinylidene fluoride-type elastomers, hexafluoropentamethylene adipate, and fluoroalkyl silicone elastomers have been evaluated and in some instances closely approach

the desired service range.

Great strides have been made toward matching the performance of rubber and air weapons. To meet the goals which will be imposed upon us in the future, however, additional new elastomers with an even broader range of service properties will be required.

EACH organization has a primary purpose toward which all expenditures of time, money, and material are directed. We in the Rubber Products Section of the Materials Laboratory have as one of our ultimate objectives the preparation of Air Force specifications on rubber materials for use in present and future air weapons. Many of the supporting tasks seem to be ends within themselves, but in reality are a part of this overall program.

In this paper I will discuss our evaluations of new rubber-like polymers, one of these tasks which has come to be important to all concerned with the role of rubber in the future. A great many polymers have been "put through the wringer" at WADC. Most have been dropped as unsuitable materials, and a far fewer number selected for future development. It is this latter group which holds our interest at this time.

The complete evaluation of a new polymer is an involved process requiring compounding studies to discover reinforcing agents, cross-linking systems, and other additives to impart specific properties. Processing characteristics, fabrication techniques, and even toxicity studies enter this evaluation as well as the obvious testing in the simulated environments of aircraft systems. The development of experimental fabrication techniques

implies the extension of present state of the art knowledge to new and perhaps entirely different materials. Without this development the full potential of a polymer cannot be realized. Later I will show some examples of WADC and industrial participation in this area.

Many times, early in the test-tube stages of a new polymer, sufficient quantities are available for only a very limited study of physical properties. This information must be reliable since it is used to guide further polymer development programs. To obtain the greatest amount of information from the least amount of material, we at WADC have spent a number of years studying semi-micro evaluation procedures.

A report just now being published on this subject will give further details.² This technique has been developed to the extent that a decision can be made with good assurance that a promising polymer has not been overlooked, and that further time spent on others is justified.

With larger quantities of a promising polymer, the

¹Presented at the Joint WADC-University of Dayton Conference of Elastomers, Dayton, O., Mar. 27-28, 1957. All illustrations used in this article are official USAF photos—courtesy of WADC.

²"The Micro-Compounding and Evaluation of Rubber-Like Polymers," WADC TR 57-247.

The Author

W. R. Griffin, materials engineer, Materials Laboratory, Wright Air Development Center, attended the University of New Hampshire and Ohio State University and received a B.S. degree in chemical engineering from the latter institution in 1954.

After six months with the Goodyear Tire & Rubber Co., he joined the WADC Materials Laboratory in 1955. His major fields of interest are polymer research and development, compounding research, and radiation effects on elastomers.

Mr. Griffin is a member of the Southern Ohio Rubber Group.



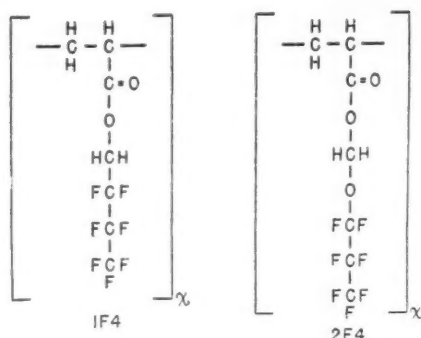


Fig. 1. Fluororubbers 1F4 and 2F4—Fluorinated polyacrylates

semi-micro compounding on our smallest mill, a 1¼-by 4-inch mill with movable guides, can be brought up to more respectable mixing quantities by the four different sized mills available. In a like manner the test specimen size and related equipment are brought up to meet with normal practice.

The need of rubber-like materials for air weapons many times has demanded that elastomers be evaluated under conditions for which they were not intended. We do not wish, therefore, to imply by the data given in this paper that certain products are inferior if used under a more normal environment. Also, some of the data presented have been recently obtained, and there is little doubt that when compounding and curing studies on these polymers have been completed, considerable improvement may be expected.

Fluororubbers 1F4 and 2F4

The first Air Force sponsored contract for the development of new polymers was with Minnesota Mining & Mfg. Co. in 1949. The objective under this contract, initially, was the development of new low-temperature fuel-resistant polymers. While the fluoroacrylates, which were the first polymers resulting from this contract, were not low-temperature rubbers, they were later found to have excellent resistance to diester-type engine lubricants. The growing demand for seals and other rubber-parts in such lubrication systems, which could resist higher operating temperatures, shifted the emphasis under this program. The experimental evaluation indicated that more than 100° F. increase in operating temperature of the oil system could be realized with this polymer. This effort is reflected in the preparation of two specifications covering seals and other components intended to be fabricated from Fluororubber 1F4. They are MIL-R-7362B³ and AMS 72ZZ.⁴

The development of fluoroacrylates and other polymers was continued under this program with increased

emphasis on low-temperature properties. The next promising polymer was Fluororubber 2F4. The chemical structures of these two elastomers shown in Figure 1 are very similar and, hence, would be expected to have similar chemical resistance. The ether oxygen of 2F4 does impart significant changes in the low-temperature behavior.

The properties of tensile strength, elongation, hardness, and, to a lesser extent, compression set of Table 1 can be modified for specific applications through compounding. The upper limit of tensile strength is very close to these figures shown here for the two polymers. Again, we see the real difference is the 40-50° F. lowering of the brittle point temperature with 2F4. Although the brittle point can be considered as the end of all desirable low-temperature properties, many applications may demand more than leather-like flexibility at low temperatures.

TABLE 1. UNAGED PHYSICALS (TYPICAL)—3M FLUORORUBBERS

	1F4	2F4
Tensile strength, psi.	1300	950
Elongation, %	400	300
Hardness, Shore durometer A	60	65
Brittle point, ° F	+12	-37
Compression set, %, after 70 hours at 250° F.,	30	55

Figure 2 shows a low-temperature retraction curve which indicates the temperature and the manner in which rubber-like properties return. To give you a feel for this property, I have sketched in the TR curve of unplasticized Paracril 18-80,⁵ the polymer used presently for low-temperature applications in fuel and hydraulic systems. The 40-50° F. brittle point advantage of 2F4 is carried through as a 40° F. gain in TR 10. This 10% retraction is often taken as the beginning of rubber-like properties. In particular, note that the TR

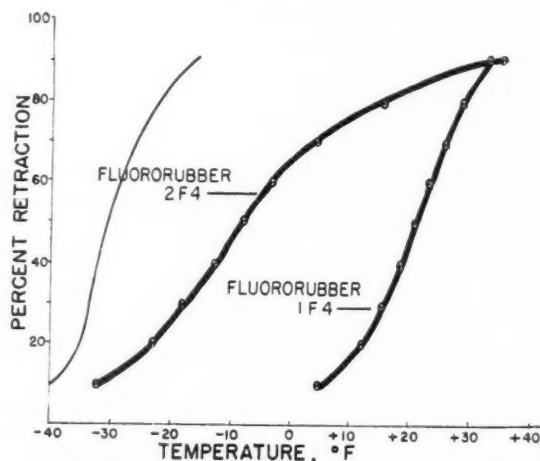


Fig. 2. Temperature retraction curves for 3M Fluororubbers. Curve on extreme left is for nitrile rubber, Paracril 18-80, for comparative purposes

³ MIL-R-7362, Proposed Revision B; Rubber Sheet, Solid, Molded, and Extruded Shapes, Synthetic Oil Resistant. Available from: Commander, WADC, Attn. WCRTR-3, Wright-Patterson AFB, Ohio.

⁴ Proposed AMS 72-ZZ; Rings, Sealing, Synthetic Rubber, Synthetic Oil-Resistant (65-75), Poly FBA Type, Society of Automotive Engineers, Inc., 29 W. 39th St., New York, N. Y.

⁵ Moderately oil-resistant nitrile rubber (NBR), Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

10 is generally 30-40° above the brittle point temperature.

These Fluororubbers have good resistance to a variety of fluids including jet fuels and other petroleum products, silicate esters, and many solvents; however, the most valuable property is the resistance to the synthetic diester-type lubricants, as shown in Figure 3. This 70-hour exposure at 450° F. does not imply service life directly, but is merely a convenient, reproducible, laboratory method of evaluation.

The percentage of original properties remaining after exposure is again a convenient method of showing the effect of the environment. It is difficult to say where this effect impairs the performance of the rubber part. We hope this difficulty is resolved with information from present contracts. Until we know the critical values of each property in each application, the actual values after exposure do not convey their full significance. The evaluation to failure in mock-up systems gives us the most reliable measure of service life today.

Processing the Fluororubbers requires more skill than most commercial polymers, but this factor can be overcome when their particular properties are demanded. Polyaniline-sulfur cures have been the most successful to date and are evaluated in detail by Technical Report WADC 55-381. WADC Technical Report 52-197, Parts 1 through 6, prepared by 3M, give more detail on these and other fluoroacrylates developed under this Air Force contract.

Kel-F Elastomers

The M. W. Kellogg Co.,⁶ working under Quartermaster Corps contract, developed the trifluorochloroethylene-vinylidene fluoride copolymer system also intended for low-temperature service. The resulting Kel-F Elastomers were evaluated and found interesting for other Air Force problem areas. The two types available differ chemically only in the monomer ratio.

The physical properties shown in Table 2 are above average for fluorine-containing polymers and differ very little between the two types. Low compression set has been the object of much compounding, but to date this seems to be a deficiency of this copolymer system.

Significant difference in the two polymers is borne out by the low-temperature retraction curves in Figure

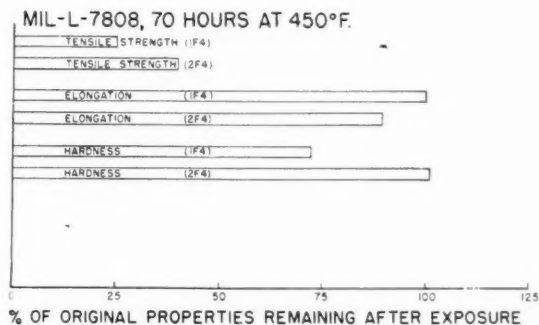


Fig. 3. High-temperature resistance of 3M Fluororubbers in synthetic diester-type lubricants

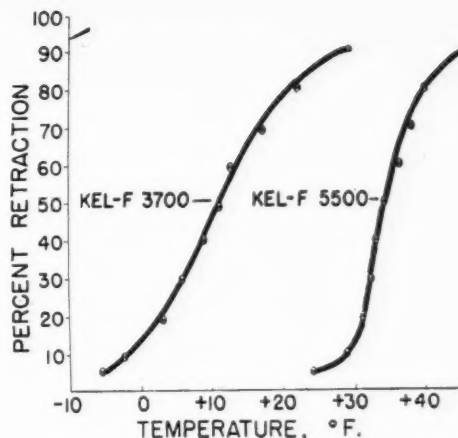


Fig. 4. Temperature retraction curves for Kel-F Elastomers 3700 and 5500

4. The 3700 brand regains rubber-like properties 25° F. below the Kel-F 5500. Of interest is the rate of recovery of the 5500 brand, requiring only 10° F. for essentially full return of rubber-like properties.

TABLE 2. KEL-F ELASTOMERS COPOLYMERS OF VINYLIDENE FLUORIDE AND TRIFLUOROCHLOROETHYLENE

Unaged Physicals (Typical)	3700	5500
Tensile strength, psi.	3150	3500
Elongation, %	360	385
Hardness, Shore durometer A	60	60
Brittle point, °F.	-60 (approx)	-60
Compression set, %, after 70 hours at 250° F.	45	65

Perhaps the outstanding property of the Kel-F Elastomers is their resistance to red fuming nitric acid. Figure 5 shows a slight advantage for the 5500 brand in RFNA and the reverse effect in 70/30 test fuel,⁷ with Kel-F 3700 having a better retention of physicals.

This excellent resistance to test fuel at room temperature is also retained after exposure to JP-5⁸ at 400° F., depicted in Figure 6. (The broken bar of elongation extends to 150% of the original.) The resistance to OS45-1⁹ after 42 hours at 400° F. is in the same order of magnitude. All properties show excellent resistance to this fluid. This test shows much promise; however, fabrication difficulties and the set characteristics have hindered the use as a hydraulic fluid seal. WADC Technical Report 55-377 describes more fully the effect of various environments on Kel-F elastomers.

⁶Now the Chemical Division, Minnesota Mining & Mfg. Co., Jersey City, N. J.

⁷ASTM Reference Fuel B, ASTM D 471-55T, American Society for Testing Materials, Philadelphia, Pa.

⁸Air Force jet engine fuel, MIL-F-5624C.

⁹Silicate ester-type hydraulic fluid, Monsanto Chemical Co., St. Louis, Mo.

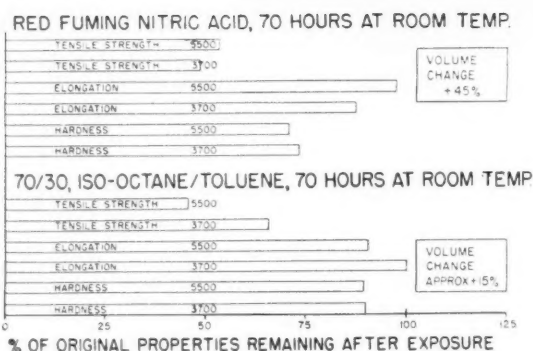
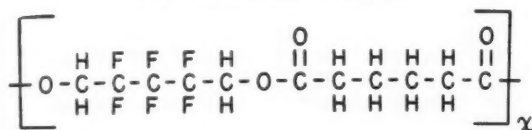


Fig. 5. Fluid resistance of Kel-F Elastomers 3700 and 5500

Hooker Fluorinated Polyester

The previous two approaches toward an extreme low-temperature fuel-resistant polymer yielded materials suitable for fuel, but without good low-temperature flexibility. Another approach seemed feasible—to take a good low-temperature rubber and add fluorine for fuel resistance.

TABLE 3. HEXAFLUOROPENTAMETHYLENE ADIPATE—A FLUORINATED POLYESTER



Original Physicals (Typical)

Tensile strength, psi.	2100
Elongation, %	420
Hardness, Shore durometer A	65
Brittle point, ° F.	-98
Compression set, %, after 70 hours at 250° F.	very large

The Hooker Electrochemical Co., under Air Force contract, has developed such a polymer. Chemically, it

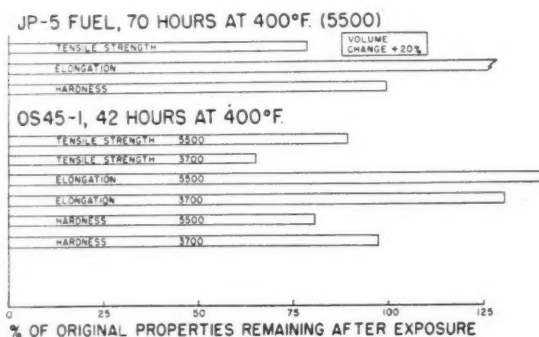


Fig. 6. High-temperature fluid resistance of Kel-F Elastomers 3700 and 5500

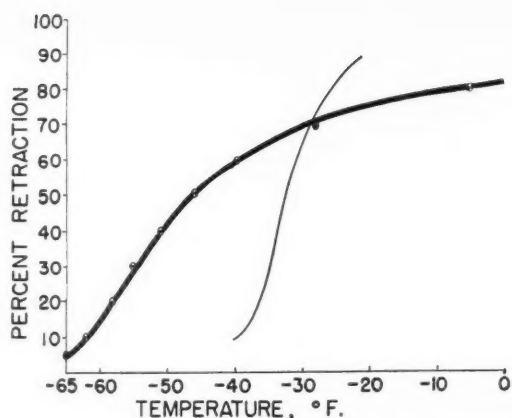


Fig. 7. Temperature retraction curve for Hooker's fluorinated polyester. Light-line curve is for nitrile rubber

is hexafluoropentamethylene adipate. The simplified structural formula is indicated in Table 3 with the typical physical properties. The physical strength of vulcanized gum is excellent and increases with reinforcing fillers. The excellent brittle point temperature of -98° F. shows that it is truly a low-temperature elastomer. At higher temperatures, as with the polyesters and urethanes, which are somewhat similar chemically, the compression set is large.

The TR curve of Figure 7 shows a material that far exceeds the low-temperature properties of the presently used nitrile rubber. We have now combined, low-temperature flexibility and excellent fuel resistance at room temperature as shown in Figure 8. Exposure at 250° F. has more effect on the elastomer, but the volume change still shows the resistance to the swelling effect of fuel and perhaps indicates promise as a fuel-tank sealant or in other applications requiring this combination of properties.

Also, much remains to be done in studying new vulcanizing systems in order to obtain a material which will be suitable for high-temperature oil and hydraulic applications.

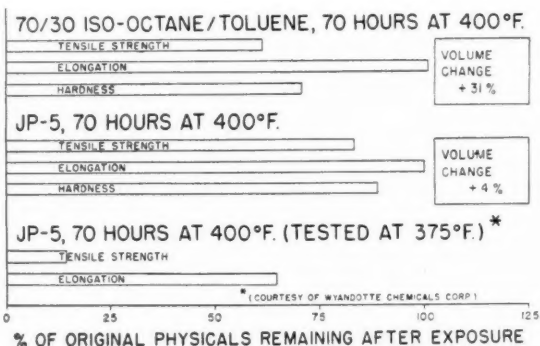


Fig. 8. High-temperature fluid resistance of Hooker's fluorinated polyester

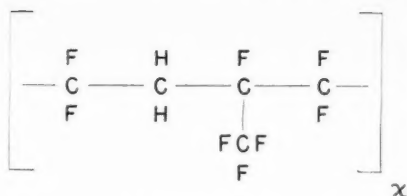


Fig. 9. Perfluoropropylene vinylidene fluoride copolymers

PFP/VF Polymers

Another of the copolymer systems to come from the previously mentioned Quartermaster Corps contract with M. W. Kellogg Co. was even more interesting for its high-temperature fluid resistance than the Kel-F Elastomers. The chemical structure is depicted in Figure 9. Evaluations of this perfluoropropylene vinylidene fluoride copolymer system, designated as system 214, supported this original observation.

TABLE 4. UNAGED PHYSICALS (TYPICAL)—PERFLUOROPROPYLENE VINYLIDENE FLUORIDE COPOLYMERS

Tensile strength, psi.	2000
Elongation, %	215
Hardness, Shore durometer A	70
Brittle point, °F.	-30
Compression set, %, after 70 hours at 250° F.	17

More recently, however, E. I. du Pont de Nemours & Co., Inc., has announced a polymer of similar composition and has made it available in somewhat more substantial quantities for experimental work. Compounding studies at WADC have confirmed the similarity of the two polymers, and the following discussions, with minor exceptions, can be assumed to apply to both materials, although the bulk of the work has been done on Du Pont's Viton A.¹⁰

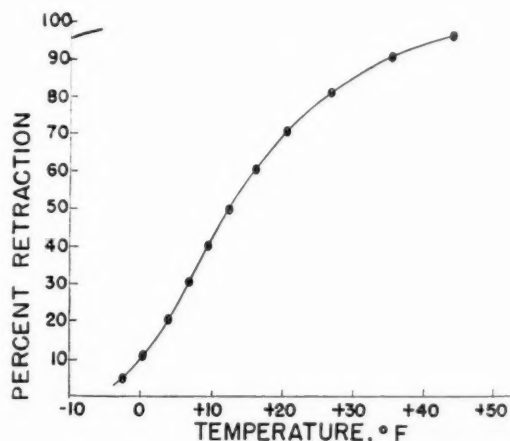


Fig. 10. Temperature-retraction curve for perfluoropropylene vinylidene fluoride copolymers (PFP/VF)

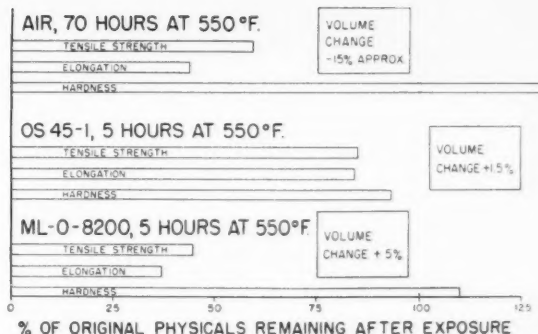


Fig. 11. High-temperature fluid resistance of PFP/VF

Original physical properties (Table 4) are good, with a reasonable brittle point temperature and excellent compression set. The TR curve in Figure 10 shows that rubber-like properties return near 0° F. some 40° F. above that of Paracril 18-80.³

The retention of physical properties in Figure 11 at 550° F. is outstanding. Three- to five-hour exposure to OS 45-1 hydraulic fluid at temperatures above 500° F. with rubber-like properties remaining has long been an unattainable goal for certain critical air weapons applications. ML-O-8200¹¹ hydraulic fluid at 550° F. has a more damaging effect, but elastomeric properties *do remain* after this five-hour exposure.

It also appears that this copolymer system may help solve a great many other harassing rubber problems that have been accumulating. Among them is radiation damage, a serious handicap for many elastomers.

During the test shown in Figure 12 an attempt was made to be realistic about this new environment and add it to the high-temperature fluid environment that may eventually be found on a nuclear powered aircraft. The results of this test were most gratifying. The tensile strength and elongation degrade slowly in a very similar manner. Tensile strength after 10×10^7 (10^8) Roentgens exposure is 220 psi., and the elongation is 120%. Whether or not these properties represent a useful mate-

¹⁰ RUBBER WORLD, May, 1957, p. 234.

¹¹ Di-siloxane-type hydraulic fluid, Oronite Chemical Co., San Francisco, Calif.

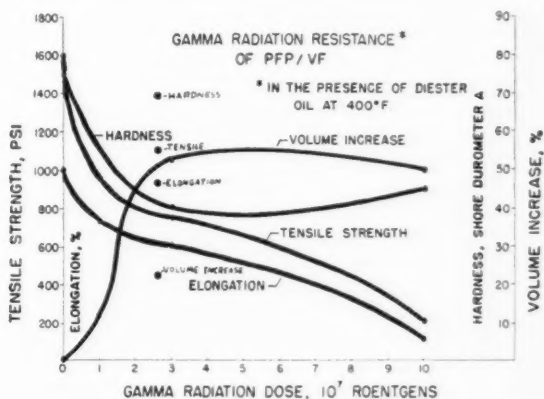


Fig. 12. Resistance to gamma radiation of PFP/VF

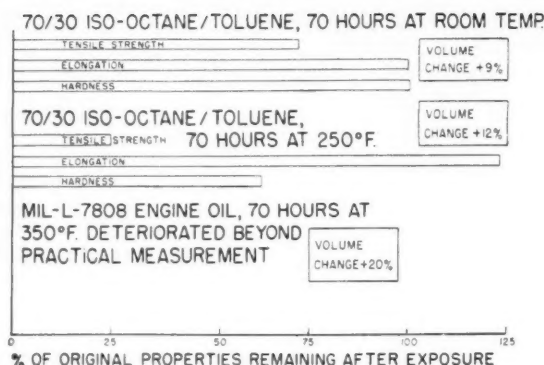


Fig. 13. High-temperature fuel resistance of PFP/VF. The rapid increase in volume at first appears to be a paradox, since cross-linking should make the material more fluid resistant. The explanation does not lie with the elastomer, but with the fluid. Analysis after irradiation shows very little change in overall viscosity of the fluid, but a marked increase in the boiling range; the low boiling fractions have a very high swelling effect on the elastomer. With more radiation-resistant fluids, this high volume increase may not be a problem.

The rapid increase in volume at first appears to be a paradox, since cross-linking should make the material more fluid resistant. The explanation does not lie with the elastomer, but with the fluid. Analysis after irradiation shows very little change in overall viscosity of the fluid, but a marked increase in the boiling range; the low boiling fractions have a very high swelling effect on the elastomer. With more radiation-resistant fluids, this high volume increase may not be a problem.

The accumulation of 10^5 Roentgens represents 260 hours' exposure to gamma radiation. This time in itself is a severe test in diesters at 400° F. A comparison to the hot oil environment without radiation can be made at 70 hours' exposure denoted by the dots. All properties are damaged by this additional environment of nuclear radiations, but this polymer represents the most high-temperature radiation-resistant material we have seen to date.

As a general statement, this polymer PFP/VF system is more resistant to more fluids than any other known

¹² Pydraul and Skydrol hydraulic fluids, Monsanto Chemical Co.

¹³ Lindol hydraulic fluid, Celanese Corp. of America, New York, N. Y.

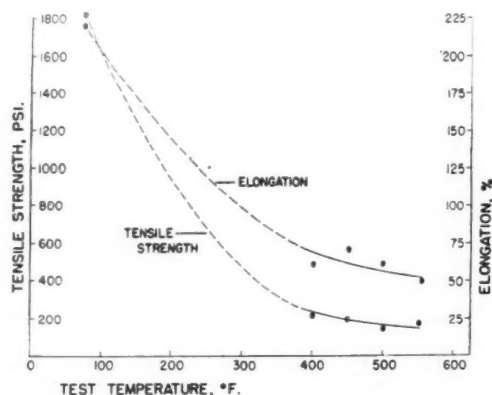


Fig. 14. The test temperature effect on physical properties of PFP/VF. (Data courtesy Firestone Tire & Rubber Co.)

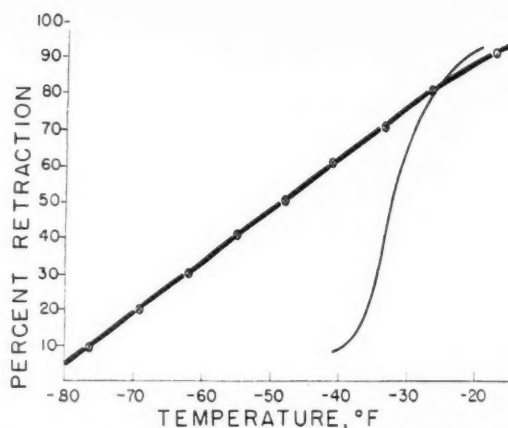


Fig. 15. Temperature retraction curve for LS-53. Light line curve on right is for nitrile rubber

elastomer today. Marked exception to this rule are the non-flammable hydraulic fluids such as Pydraul,¹² Lindol,¹³ and Skydraul.¹² The effect in these fluids is excessive swelling.

In Figure 13, the resistance to fuel is remarkable after exposure, when measured at room temperature—perhaps the best we have seen. But when tested at or near the temperature of exposure, the properties remaining are drastically reduced. This same effect is seen when the physicals are measured in air at elevated temperatures as shown in Figure 14.

Now more than ever before design of seal cavities and other components is going to effect the serviceability of rubber end-items under these high-temperature conditions. It is also apparent that the problems of maintaining high-temperature serviceability of rubber components are accumulating. First, we have low physicals due to fluid attack and thermal degradation. Now we have additional loss due to temperature alone.

These problems are aggravated by thermal expansion and contraction of rubber over the extended service temperature range. For instance, Viton A has possibilities of service between -65 and 600° F. Over this

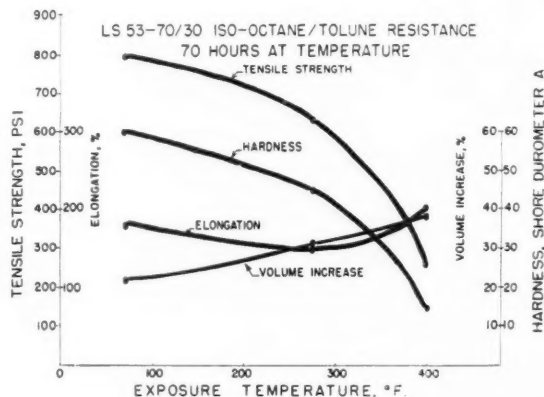


Fig. 16. Resistance of LS-53 to ASTM test fluid B (70/30 isooctane/toluene)

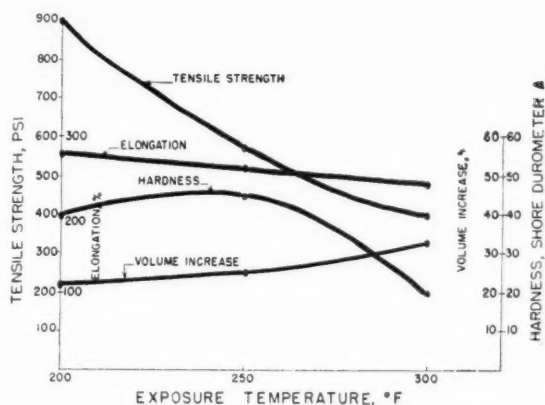


Fig. 17. Resistance of LS-53 to JP-5 jet fuel after 150 hours at temperature indicated

temperature range of 665° F., the thermal expansion amounts to a change of approximately 20% in the volume. I'll not try to offer a solution at this time—just a problem.

Silastic LS-53

The final class of new rubbers to be discussed are the fluorosilicones. It would seem logical to add fluorine to silicone elastomers to increase their fluid resistance, and such a polymer is now available in experimental quantities. Silastic LS-53 was the result of the combined efforts of several Air Force contractors and Dow Corning Corp. In Table 5 the physical properties of this new fluorosilicone are typical of silicone elastomers with the possible exception of lower elongation. The retention of the good low-temperature properties was very gratifying since the addition of fluorine to organic elastomers appeared to decrease this flexibility.

The LS-53 regains rubber-like properties at -85° as shown by the TR curve in Figure 15, unusually close to its brittle temperature of -90° F. However, 100° F. are required for full recovery. The range of temperature combined with fuel resistance of this elastomer is excellent—being nearly 500° F. Applications in areas of fuel hose, seals, diaphragms, and sealants seem very promising from the screening with 70/30 test fluid

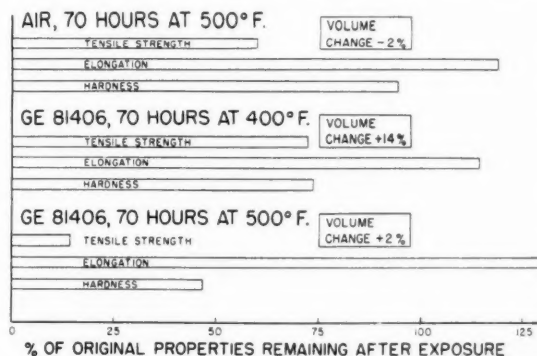


Fig. 18. High-temperature fluid resistance of LS-53 (G-E 81406)

TABLE 5. LS-53 SILICONE RUBBER—A LOW-SWELL, FLUORINATED ALKYL, SILICONE ELASTOMER

Unaged Physicals (Typical)

Tensile strength, psi.	1100
Elongation, %	185
Hardness, Shore durometer A	60
Brittle point, ° F.	-90

shown in Figure 16. In Figure 17, we see that fuel used in jet engines is less detrimental than the test fluid, apparently allowing twice the service life. With this outstanding resistance to fuel over this range, the possibility of other fluid resistance arises. In Figure 18, LS-53 has good resistance to hot air aging, and to G-E 81406¹⁴ experimental hydraulic fluid at 400° F. At 500° F. the G-E 81406 has a more damaging effect, but the elastomer does not harden and shrink as do most others.

OS 45 and 85/15¹⁵ hydraulic fluids and, to a lesser degree, diester-type lubricants reduce the tensile strength and hardness severely after 70 hours at 400° F. This Figure 19¹⁶ shows that the fluorosilicone elastomers must be improved for high-temperature service life with these fluids. Since this type of elastomer is in the early stages of development, we feel hopeful that future modifications will have a broader temperature range of serviceability.

Discussion of Results

More and more the requirements are for elastomers with broad temperature ranges of useful life. Unfortunately, we do not have an elastomer capable of -100 to +600° F. service in a variety of fluids. We are beginning to wonder if such a material will ever exist. The only practical approach will be to cover the range

¹⁴ Also designated as Versilube F-50. A chlorophenylmethyl silicone fluid. General Electric Co., Schenectady, N. Y.

¹⁵ Experimental fluid 85/15 consists of 85% di-siloxane-type and 15% diester-type fluid. Oronite Chemical Co.

¹⁶ Anderol L774 in Figure 19 is standard test fluid of diester type. Composition is di-2-ethylhexyl sebacate plus 1/2% phenothiazine. Lehigh Chemical Products Co., Chestertown, Md.

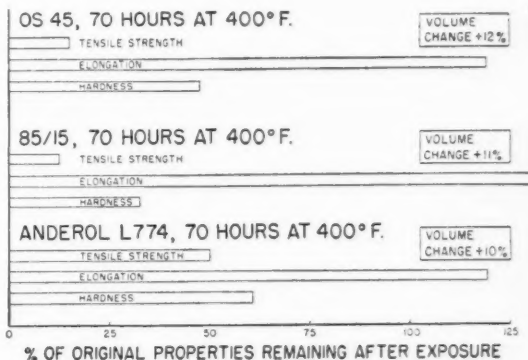


Fig. 19. High-temperature fluid resistance of LS-53 (OS 45; 85% di-siloxane-type and 15% diester-type fluid; Anderol L774)

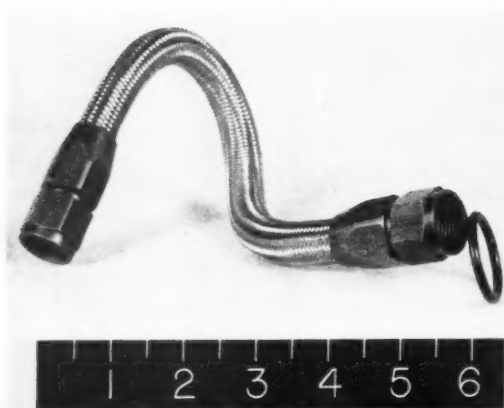


Fig. 20. Aircraft hydraulic hose fabricated with Viton A

with as few number of polymers as possible. With this thought in mind let us consider the useful ranges of the elastomers discussed in this paper.

Fluororubber 1F4 is a specification material and retains useful rubbery properties from $+12$ to 450° F. in diester-type engine lubricants. Fluororubber 2F4 extends the lower limit to -35° F., but as yet is an experimental material in limited quantities. The two Kel-F elastomers held interest for -60 to 400° F. applications—especially in fuels. They are commercially available and to date are practically the only elastomers for prolonged use with RFNA.

Hexafluoropentamethylene adipate has a -98 to approximately 300° F. range for fuels and is an extreme low-temperature material. It has the particular advantage of being easily manufactured in a variety of molecular weights and may find extended use as a fuel-tank sealant, especially since it resists hardening at high temperatures.

The perfluoropropylene vinylidene fluoride copolymer system has outstanding high-temperature fluid resistance, with a possible -65 to 600° F. range. It may soon be a specification material for nearly all the high-temperature fluid applications.

Silastic LS-53 is a medium low-temperature, fuel-resistant silicone rubber with -90 to 400° F. service-

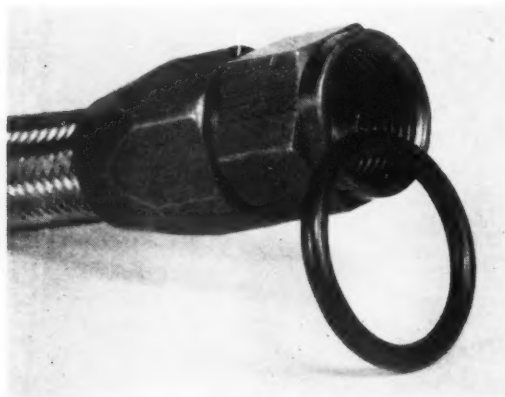


Fig. 21. O-ring of Viton A

able range. This polymer is in limited experimental quantities at present, but holds a great deal of interest for Air Force application, perhaps because it represents the first elastomer of the new family of fluorinated silicones.

These laboratory evaluations are important because they indicate a relative measure of service life. More reliable data, however, are obtained from evaluating end-items under simulated service conditions. Much of the fabricating and testing with a new polymer is conducted at WADC, but often we rely upon the excellent cooperation of industry to help us in this task. An example of this cooperation can be shown in end-items fabricated with Viton A.

Viton A End-Products

High- and low-pressure aircraft hydraulic hose has been fabricated, and tests to date indicate it to be superior to any rubber-containing hose available for high-temperature fluids. A small size is shown in Fig-



Fig. 22. Fuel-cell test cube of Viton A

ure 20. It is interesting to note that 0-1000 psi. pulsing at -65° F. does not damage the hose even though the stock is brittle on bending. Vibration tests at -65° F. may be equally interesting.

O-ring seals like those of Figure 21, although a minor part by weight of an engine or hydraulic system, are essential to its performance. The close-up of this AN 6227-19¹⁶ O-ring shown with the hose reveals the good molding characteristics of this WADC developed recipe. Rejects from O-ring molding, even with sloppy preforms, have been exceptionally low with this formulation. These rings have been cycled from -65 to 600° F. in an experimental hydraulic fluid, with outstanding performance.

Skin friction of supersonic aircraft will cause high temperatures to develop in fuel-cell walls and may be-

(Continued on page 701)

¹⁶ AN 6227-19 is drawing for hydraulic O-rings. Available from: Commander, WADC, Attn. WCLSM-2, Wright-Patterson AFB, Ohio.

A Versatile New Family of Elastomers—II¹

By G. E. MEYER, W. E. GIBBS, F. J. NAPLES, R. M. PIERSON, W. M. SALTMAN,
R. W. SCHROCK, L. B. TEWKSURY, G. S. TRICK

Goodyear Tire & Rubber Co., Akron, O.

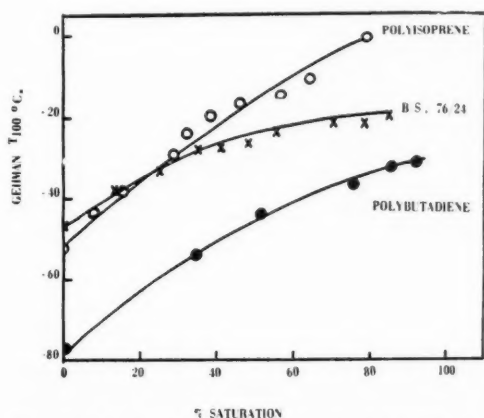


Fig. 7. Effect of saturation level of MeSH-BR, MeSH-IR, and MeSH-SBR (76.24) adducts on Gehman T_{100} values

LOW temperature stiffening and embrittlement of adduct elastomers has been examined as a function of the extent of saturation, chain length of mercaptan, and composition of base polymer—the latter of which is treated in the following section on swelling properties. For adducts of the low molecular weight mercaptans and a particular base polymer, the glass transition temperature, T_g , rises as the saturation increases, the rate at which it rises being a characteristic of the base polymer. This property is shown by Figure 7 where Gehman T_{100} values (approximately equal to T_g) are plotted against saturation levels.

Low Temperature Flexibility

The influence of mercaptan chain length on T_g is illustrated by the data plotted in Figure 8. Two levels of saturation are shown.

The unusual shapes of the curves are the consequence of several opposing influences: (1) for the lower mercaptans, the introduction of the polar sulfur atom at a high fraction of the double bonds detracts markedly from low temperature flexibility, an influence which is abetted by the ease of chain packing of the short side

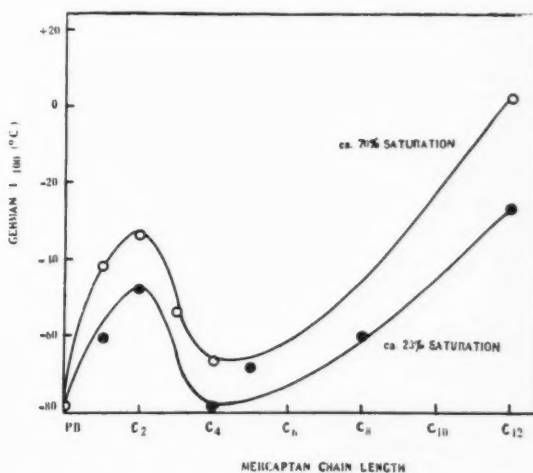


Fig. 8. Effect of mercaptan chain length of adduct polymer of about 23 and 70% saturation on Gehman T_{100} values

chains; (2) as the side chain lengths are further increased (C_7 - C_{12}), the ease of packing at low temperatures is greatly lessened, a phenomenon also observed for the acrylate and methacrylate ester polymers (31)² and for p-alkyl substituted styrene polymers (32); (3) for long aliphatic side chains (C_7 and up), the tendency of the latter to be immobilized into their own crystals plays an important role in determining brittle temperature (no measurements for detecting actual crystallization have yet been run, however).

The similarity in the shapes of the curves at such widely differing saturations is itself quite noteworthy.

Solvent Swelling

SOLUBILITY PARAMETERS IN PURE LIQUIDS. To ascertain the change in solvent resistance associated with increase in degree of saturation (see following sections), the Flory-Huggins solubility parameter μ (27a,b) was determined for several elastomer-solvent systems. From the swelling of cured samples in benzene and the corresponding μ determined in the same solvent the value of M_c could be calculated. Using this value of M_c , the value of the solubility parameter for other solvents could be calculated from swelling measurements. Two samples of adduct rubber were employed and each was cured to two levels of M_c . The values are given in Table 5 where all swelling volume results are the average of two determinations.

The swelling volumes for the two types of adduct and the calculated μ values are also given in Table 5. It may

¹Based on a paper presented before the Joint Wright Air Development Center-University of Dayton Conference, Dayton, O., Mar. 27-28, 1957, by Dr. Meyer. This same paper was presented before the International Synthetic Rubber Symposium, London, England, Mar. 26-28, 1957, organized by the *Rubber and Plastics Age*, London. Simultaneous publication in *RUBBER WORLD* and *Rubber and Plastics Age* has been arranged for in view of the above facts. This installment is continued from our July issue, p. 529.

²Numbers in parentheses refer to Bibliography items on p. 536, our July issue.

TABLE 5. SOLUBILITY PARAMETERS OF ADDUCT RUBBER

A. Properties of Cured Samples (Gum Stock)

Polymer	Swell-ing Volume (vol/vol)	μ	Calcu- lated M_e
65.5% sat'd. BR/MeSH adduct Cure A	5.44	0.39	12,800
65.5% sat'd. BR/MeSH adduct Cure B	5.34	0.39	10,900
89.5% sat'd. BR/MeSH adduct Cure A	4.62	0.42	12,800
89.5% sat'd. BR/MeSH adduct Cure B	3.79	0.42	7,100

B. Swelling Volumes for 65.5% Saturated BR/MeSH Adduct

Solvent	Cure A		Cure B	
	Swell-ing Volume	μ	Swell-ing Volume	μ
Carbon tetrachloride	6.34	0.32	5.64	0.34
p-Xylene	5.20	0.35	4.62	0.34
75% Iso-octane, 25% toluene	1.05	0.73	.....	.....

C. Swelling Volumes for 89.5% Saturated BR/MeSH Adduct

Solvent	Cure A		Cure B	
	Swell-ing Volume	μ	Swell-ing Volume	μ
Carbon tetrachloride	5.35	0.38	3.84	0.38
p-Xylene	4.47	0.40	3.26	0.39
75% Iso-octane, 25% toluene	0.66	0.85	0.60	0.85

be seen that an increase in the degree of saturation produces a small but significant increase in the solubility parameter, confirming the increased solvent resistance at the higher saturation level.

SOLVENT RESISTANCE IN OILS AND FUELS. Addition of methyl mercaptan produces elastomers having considerably better solvent resistance than the base polymers, the solvent resistance increasing with saturation as shown in Table 6.

Above approximately 50% saturation, the adducts of polybutadiene are more resistant to many oils and fuels of practical interest than is neoprene under similar conditions. The 80 to 90% saturated adducts approach commercial types of 80/20 butadiene/acrylonitrile (NBR) copolymers. To attain greater solvent resistance, adducts of appropriately chosen NBR base polymers make possible nearly any desired degree of solvent resistance. The 78% saturated adduct of 90/10—NBR copolymer has solvent resistance characteristics intermediate between those of the unadducted 80/20 and 67/33 NBR copolymers.

Data in graphical form are given in Figure 9 which illustrate how solvent resistant polymers with improved low temperature flex properties may be prepared. The Gehman low temperature flex values of NBR and adducts of NBR copolymers at various B/N ratios are plotted against volume swell in a commonly used reference fuel. These results, along with those given in Table 6, indicate that an 80/20 NBR copolymer 80% saturated with methyl mercaptan has a solvent resistance

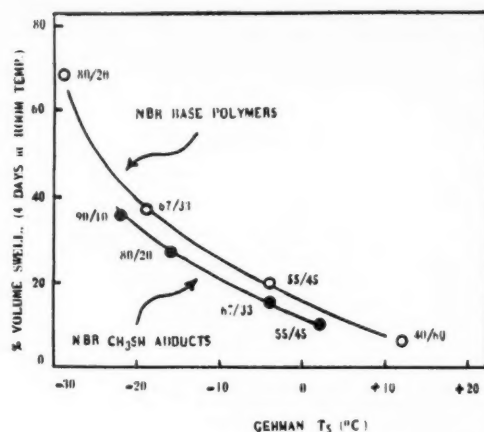


Fig. 9. Low-temperature flexibility values (Gehman T_5) versus swell in 70/30 iso-octane/toluene for NBR and NBR-MeSH adduct polymers of varying nitrile content

equal to the 67/33 unadducted copolymer and is flexible at a temperature at least as low as the latter. An added advantage is increased high temperature stability of the adducted polymer.

With respect to the effect of mercaptan chain length on swelling in fuels, evaluations of the adducts of polybutadiene have shown that volume swell in a 70/30 isooctane/toluene mixture of fuel (a standard reference mixture) is more a function of mercaptan chain length than it is of the extent of cure. The table below lists typical data obtained showing the increased swell with the adducts of C_1 , C_2 , and C_3 mercaptans.

Mercaptan	% Saturation	Volume Swell in Fuel-type Mixture*
Methyl	76	2.4
Ethyl	70	3.2
n-Propyl	73	3.4

*Cc. of swollen sample per cc. of original stock. This is a different basis of reporting than the "% Swell" figures of end-product type compounds given in the preceding section.

CAPACITY FOR ABSORBING EXTENDER OILS. Certain potential applications of the adduct elastomers will involve compositions where it may prove possible to use the common type of extender oils, which are so widely used in cold SBR, to attain lower costs without adversely affecting whatever performance features are being sought.

In order to gain some notion of the capacity of the cured stocks to "hold" oil without bleeding, a number of typical extender oils—covering a wide range of aromatic oil content—were used as swelling agents for a 70% saturated methyl mercaptan-polybutadiene adduct which had been fully cured in a standard sulfur-type recipe. Table 7 summarizes the data, in which the swelling of a hydrocarbon rubber (cold 50 ML SBR) are included for comparison.

It is quite evident that the less aromatic oils cannot be used at the customary concentration levels (25-50

TABLE 6. SOLVENT RESISTANCE OF VARIOUS BASE POLYMERS ADDUCTS IN BLACK LOADED STOCKS

Polymer*	Adduct of Poly B	Adduct of Poly B	Adduct of Poly B	Adduct of 90/10 NBR	Adduct of 80/20 NBR	Adduct of 65/35 NBR	Neoprene GNA	Control 80/20 NBR	Control 67/33 NBR
CH ₃ SH Saturation, %	59	82	90	78	65	60	..	..	..
% Volume Swell After 70 Hours at 250° F.									
Type A Auto Trans Oil	26	12	11	6.3	3.5	0.3	39	..	..
ASTM #3 Oil**	57	39	39	25	18	8.7	81	38	18
48 hours at room tempt.									
Ref. Fuel B (standard mixture of aliphatics and aromatics)***	41	36	35	32	36	19	49	..	..
7 days at 77° F.									
Isooctane	..	7	..	3.7	..	..	15	14	3
70/30, Isooctane/benzene	..	46	..	33	..	..	64	42	29
ASTM #3 Oil	..	4	..	2.9	..	..	..	8.5	2.5
Esso Turbo Oil #15****	..	..	..	7.8	..	..	..	24	7
Kerosene	..	20	..	13	..	..	..	28	11

* Polymers contained 50 parts HAF or FEF black and were cured in conventional sulfur-accelerator recipes except neoprene which had MgO for curing. All had normal physical properties for the loadings used.

**ASTM D 471-55T Table 1.

***ASTM D 471-55T Table 2.

****Esso Standard Oil, New York, N. Y.

TABLE 7. SWELLING IN EXTENDER OILS

Commercial Name of Oil	% Aromatic Content*	Cc. oil/cc. Elastomer, sorbed into pre-cured	
		Adduct of BR/MeSH	SBR 1502**
Necton 60 (Enjay)	21	0.16	1.22
Circosol 2-XH (Sun)	44	0.39	1.60
SPX-97 (Shell)	69	1.06	2.34
Cauliflux GP (Golden Bear)	75	1.30	2.44
Dutrex 20 (Shell)	93	1.51	2.38
Benzene			

* As estimated roughly by silica gel method. The various oil manufacturers' methods for rating aromatic content are not always in concordance. Hence these values are only approximate.

** Plioflex 1502, Goodyear Tire & Rubber Co., Chemical Div., Akron, Ohio.

parts/100 of rubber) in the case of the adduct polymer. The difference in sorption capacity between the adduct elastomer and SBR 1502 decreases as the aromatic content of the oil increases.

High Temperature Properties and Age Resistance

Preliminary screening tests were made on a few of the more heat resistant rubbers, both as raw elastomers and as cured gum stocks, to evaluate their stability at high temperatures.

Table 8 summarizes observations made on the raw elastomers. The adduct rubbers contained 1.25% of a non-staining phenolic antioxidant—i.e. were not stabilized for maximum heat resistance. The other elastomers were used as received. Earlier aging tests at 300° F. had

TABLE 8. HIGH TEMPERATURE (500°F) AGING OF RAW ELASTOMERS

Elastomer	1 Hour, Appearance	4 Hours, Appearance	Weight Loss*
Kel F-214**	Slight darkening	Light brown color throughout	0.4%
CH ₃ SH-Adducts			
97% Sat. BR	Darkened thin skin on exposed surface	Thin black resinous skin on exposed surface Interior appeared unchanged Some distortion of sample	3.4
90% Sat. BR	As above	As above	3.6
Hycar PA-21***	As above	As above except some bubble formation	6.4
Viton A****	Black melted surface, spongy, expanded to about 5 times original volume. Strong acidic odor while hot	Very little change on further aging	
Neoprene GN*****	Black and brittle like charcoal	No significant change after 1 hour	12.8
Hypalon****	Dark brown blown sponge, several times original volume. Considerable decomposition	Not much change in appearance, but much more brittle	19.3

* Corrected for moisture content as determined by 2 hours heating at 220° F. under 28 inches of vacuum.

**Minnesota Mining & Mfg. Co., Chemical Div., Jersey City, N. J.

***B. F. Goodrich Chemical Co., Cleveland, O.

****E. I. du Pont de Nemours & Co., Inc., Elastomers Dept., Wilmington, Dela.

shown such rapid deterioration of conventional diene rubbers (SBR, natural rubber), even when protected with "strong" antioxidants, that these were not included in the 500° F. tests. On the basis of appearance Kel F-214, a fluoroelastomer, was the least affected by 4 hours aging at 500° F.

The highly saturated methyl mercaptan adducts of polybutadiene appeared to withstand the heat exposure somewhat better than Hycar PA-21 (an ethyl acrylate polymer), which in turn appeared better than Viton A, another fluoroelastomer. On the basis of weight loss, Kel F-214 was also best, Viton A next, followed by the adduct elastomers.

It is not known how significant are the figures on apparent weight loss, since there may have been concurrent formation of nonvolatile oxidation products.

Cured gum stocks of the elastomers, with the exception of Kel F-214 and Viton A, were aged at 300 and 500° F. for various periods of time. The highly satu-

rated adducts of polybutadiene appeared to be outstanding in their ability to retain a considerable portion of their original tensile and elongation for several days at 300° F. and up to 3 or 4 hours at 500° F.

In further work, tread type formulations have been tested as well as aged at high temperature. Table 9 lists the first results obtained at 400 and 500° F. The highly saturated adduct polymers appear to possess and retain the best balance of tensile and elongation values found in this series of elastomers. It is believed that even further improvement in high temperature aging will be realized as more is learned about its basic aging properties.

Ozone Resistance

Highly saturated methyl mercaptan adducts of polybutadiene have proven to have outstanding resistance to degradation when exposed to ozone at 100° F. under both static and dynamic conditions. (Table 10.) The 90 and 97% saturated adducts, as well as butyl rubber, with no added protective agents (other than antioxidants included in the preparation of the raw polymers) showed no degradation after a total exposure including 200 hours at 50 parts per hundred million, 24 hours at 2000 pphm and 24 hours at 2750 pphm of ozone.

Next in resistance were the 82% saturated adduct and Neoprene GN which appear to have about equal resistance to ozone degradation, but were significantly more susceptible to attack than the first three. The 69% saturated adduct without added antiozonant appears to be approximately on a par with Plioflex 1710 (oil extended cold SBR) containing an effective antiozonant.

Gas Permeability

In his studies of the gas permeability of various elastomers Van Amerongen (33) concluded that (1) low level of unsaturation; (2) high concentration of methyl groups (many short branches); and (3) polar groups were all conducive to low gas permeability of an elastomer. The highly saturated methyl mercaptan adducts of polybutadiene should therefore approach the ideal in this characteristic.

TABLE 9. HIGH TEMPERATURE PROPERTIES OF BLACK LOADED STOCKS*

Elastomer (% values are degrees of saturation)	Tensile psi Elongation %				
	Original Measured at				Aged 2 hrs. (@ 400° F 77° F
	77° F	400° F	500° F	500° F	
88% CH ₃ SH-BR	2785/550	490/285	310/185	2000/255	1900/460
90% " "	1770/715	420/315	210/220	1900/460	1900/460
Philprene VP-A†	3190/445	480/200	146/23	890/190	890/190
Viton A	1440/200	270/90	270/90	270/90	270/90
Acrylon EA-5‡	1890/245	410/105	290/100	1960/115**	1960/115**
Acrylon EA-5****	1875/480	580/160	340/110	340/110	340/110
Natural Rubber**	3850/480	500/500	20/10	20/10	20/10
Neoprene***	3550/480	770/100	215/10	215/10	215/10

* Adducts and Philprene VP-A stocks contained 50 pts. ISAF black; Viton A, 20 pts. MT (as recommended by duPont); Acrylon EA-5 and natural rubber, 50 pts. HAF; and neoprene 50 pts. MPC. Cure recipes were those recommended for maximum heat aging.

** Aged 90 hrs. at 300° F. which our experience has shown to be about equivalent to 2 hrs. at 400° F.

*** Data from WADC Technical Report 56-331.

† Phillips Chemical Co., Akron, O.

‡ Borden Co., Chemical Div., Chicago, Ill.

TABLE 10. OZONE RESISTANCE OF ELASTOMER GUM STOCKS AT 100° F.

Elastomer	Static ^(a) Exposure	Dynamic ^(a) Exposure
97% Sat. MeSH-BR	No cracks at end of experiment ^(b)	No cracks at end of experiment ^(b)
90% Sat. MeSH-BR	No cracks at end of experiment	No cracks at end of experiment
Butyl	No cracks at end of experiment	No cracks at end of experiment
82% Sat. MeSH-BR plus AOz ^(c)	No cracks at end of experiment	Sample broke at clamp after 105 hrs.
Neoprene GN plus AOz	No cracks at end of experiment	Moderate cracking after 24 hr. at 2000 ^(d) pphm.
69% Sat. MeSH-BR plus AOz	No cracks at end of experiment	Visible cracks after 24 hr. at 2000 ^(d) pphm.
82% Sat. MeSH-BR	Visible cracks after 50 hrs. at 50 pphm.	Microscopic cracks after 50 hrs. at 50 pphm
Neoprene GN	Same as above	Same as above
69% Sat. MeSH-BR	Severe cracks after 50 hrs at 50 pphm.	Moderate cracks after 50 hrs. at 50 pphm.
SBR* 1710 plus AOz	Visible cracks after 40 hrs at 50 pphm.	Microscopic cracks after 40 hrs. at 50 pphm.
SBR 1710 no AOz	Severe cracks after 40 hrs at 50 pphm.	Failed during 40 hrs. at 50 pphm.

^(a) Described in text.

^(b) Total exposure during experiment included 200 hrs. at 50 ± 5 pphm.

24 " " 2000 ± 5 " "

24 " " 2750 ± 5 " "

^(c) AOz indicates 4 pts. of an effective antiozonant added.

^(d) Including 200 hrs. at 50 pphm.

* Plioflex 1710, Goodyear.

Hydrogen and air permeability values for various adduct stocks as well as for several commercial elastomers are listed in Table 11. These results show (1) an inverse relation between extent of saturation and permeability; (2) that the best adduct gum stocks have about four and five times the resistance to hydrogen permeability shown by polybutadiene and natural rubber, respectively, and about half that of butyl. In black stocks, which are of much more practical interest, the highly saturated methyl mercaptan adducts of polybutadiene are equivalent to butyl.

A range of values is given in some instances where different batches of the same stock have been tested. Similar excellent performance for the adducts is also found for air permeability in black stocks.

Exposure to Gamma Radiation

RESISTANCE TO DETERIORATION OF PRE-CURED COMPOUNDS. Eighty-nine per cent saturated methyl mercaptan polybutadiene adduct, neoprene, and natural rubber were compared in their ability to resist degradation when exposed to radiation (gamma rays) from a Cobalt 60 source, using conventional reinforced stocks of the type used in commercial products.

The results given in Table 12 show the serious deleterious effect on the neoprene and natural rubber stocks at an exposure of 10^8 REPs, in line with the results reported by the Goodrich studies (29). The increase in tensile (probably due simply to further cross-linking) with a retention of over 60% of its original elongation by the adduct elastomer under the same conditions indicates high resistance to degradation by gamma radiation.

Inasmuch as natural rubber itself has been rated by the Goodrich studies (29) as one of the elastomers most resistant to gamma radiation (an observation also made in other studies in this laboratory), the performance of the stock based on adduct rubber makes the latter class of elastomers look extremely promising from the standpoint of the many critical rubber uses involving radiation exposure.

GAMMA RADIATION AS A MEANS OF CURING. Methyl mercaptan adducts of polybutadiene at saturation levels from 0 to 97% were irradiated for varying exposure times. Swelling volume measurements on these samples, listed in Table 13, show that considerably fewer cross-links are formed in the highly saturated elastomers.

These results indicate that a 97% saturated adduct, precured in a compounded stock, should give even better resistance to degradation than that observed above with the 89% saturated material.

Compatibility of Adduct Elastomers with NR and SBR

The effect of saturation level and molecular weight of the mercaptan on compatibility of adducts with natural rubber and Plioflex 1502 was examined by Dobry's solution separation technique (30).

The numerical values given in Table 14 indicate that the compatibility of adducts of polybutadiene with the hydrocarbon elastomers (1) decreases with increasing saturation; (2) increases with increased molecular weight of the mercaptan at equivalent saturation levels; and (3)

TABLE 11. HYDROGEN AND AIR PERMEABILITY OF ELASTOMERS AT ROOM TEMPERATURE

Elastomer	Type of Stock	Hydrogen Permeability 1 m ² 24 hr. 0.001"
Butyl	Gum	14*
97% CH ₃ SH-BR Adduct	"	27
82 " "	"	30
69 " "	"	34
Polybutadiene	"	109**
Natural Rubber	"	127**
Butyl	30 pts. MPC	3.9-10.7
97% CH ₃ SH-BR	50 pts. HAF	4.9
90% " "	" " "	3.1-6.0
		Air Loss
Natural Rubber	Carcass	1 (Arbitrary Unit)
Blend, 75/25, NR/77% CH ₃ SH-BR	"	0.70
Blend, 50/50, NR/77% CH ₃ SH-BR	"	0.45
Blend, 25/75, NR/77% CH ₃ SH-BR	"	0.24
77% CH ₃ SH-BR	"	0.16
Butyl	Tube	0.15

*Van Amerongen (33) reports 18.7 at 25°C.

**From Van Amerongen (33).

TABLE 12. EFFECT OF GAMMA RADIATION ON CURED BLACK STOCKS

Elastomer	Adduct*	Neoprene GN	Natural Rubber
Total pigment	55 parts	26 parts	33 parts
Tensile, psi			
Original	1800	2900	3650
After 0.05×10^8 REPS**	1925	2650	2975
After 1.0×10^8 REPS**	2550	500	625
Elongation at break, %			
Original	580	900	605
After 0.05×10^8 REPS	550	835	525
After 1.0×10^8 REPS	350	120	140
300% Modulus, psi			
Original	1000	350	950
After 0.05×10^8 REPS	1150	375	1000
After 1.0×10^8 REPS	2325	..	..

*89% saturated methyl mercaptan adduct of polybutadiene.

**One rep is that quantity of ionizing radiation which, upon absorption in body tissue, is accompanied by the gain of 93 ergs of energy per gram of tissue. Rep is an abbreviation of roentgen equivalent physical.

TABLE 13. THE EFFECT OF GAMMA RADIATION ON RAW CH₃SH-BR ELASTOMERS OVER A RANGE OF SATURATION LEVELS

Saturation %	Swelling Volume in Benzene after Exposure to		
	2×10^7 REPs	4.5×10^7 REPs	6×10^7 REPs
0	7.3	5.5	4.8
34	8.5	5.6	4.7
47	8.5	5.6	4.7
67	8.5	5.9	4.7
76	7.7	5.9	4.9
86	9.8	6.2	5.5
93	13.9	9.5	7.0
97	15.2	9.9	8.1

TABLE 14. SOLUTION COMPATIBILITY OF ADDUCT POLYMERS WITH NATURAL RUBBER AND SBR 1502 (PLIOFLEX)

Base Polymer	Mercaptan	Saturation %	Compatibility*	
			Nat. Rubber	SBR 1502
Polybutadiene	Methyl	12	>7.0	>7.0
Polybutadiene	Methyl	23	5.8	>7.0
Polybutadiene	Methyl	30	5.5	>7.0
Polybutadiene	Methyl	42	3.5	6.5
Polybutadiene	Methyl	58	3.0	4.9
Polybutadiene	Methyl	64	3.0	4.5
Polybutadiene	Methyl	79	2.5	3.5
Polybutadiene	Ethyl	60	4.5-5.0	>7.0
Polybutadiene	Ethyl	70	3.0-4.0	5.0-5.5
Polybutadiene	Propyl	86	>7.0	5.0-6.0
Polybutadiene	Butyl	75	>7.0	>7.0
Polybutadiene	Butyl	80	>7.0	6.5
Polybutadiene	Amyl	55	>7.0	6.0-7.0
Polybutadiene	Dodecyl	74	>7.0	>7.0
Polybutadiene	Dodecyl	86	>7.0	5.0-6.0
Polybutadiene	Dodecyl	95	>7.0	3.5-4.0
85/15 Bd/Styrene	Methyl	83	3.0-3.5	4.0-4.5
75/25 Bd/Styrene	Methyl	85	2.5-3.0	4.0-4.5
Polyisoprene	Methyl	66	6.0	>7.0
50/50 Bd Isoprene	Methyl	89	3.3	4.8

*Maximum concentration of polymers in toluene at which phase separation does not occur.

the methyl and ethyl adducts are more compatible with SBR 1502, while the higher molecular weight mercaptan adducts are more compatible with natural rubber.

Methyl mercaptan adducts of styrene/butadiene elastomers show only slightly more compatibility than similar adducts of polybutadiene. The methyl mercaptan

TABLE 15 ADDUCT POLYMERS FOR RADIATOR COOLANT HOSE

	SAE 20R1 Specification	67 Adduct/33 Hydrocarbon Rubber	43 Adduct/57 H.C. Rubber
Original			
Durometer hardness	55 to 75	73	73
Tensile, psi.	1250 min.	1650	1265
Elongation, %	250 min.	390	270
Oven Aging 70 hrs. @ 212° F.			
Durometer change	+20 max.	+7	+8
Tensile change, %	-15	+13	+28
Elong. change, %	-50	-41	-22
After immersing 70 hrs. @ 212° F. in ASTM #3 oil			
Volume increase, %	+100	+63	+61
Tensile change, %	-60	-48	-57
After refluxing 70 hrs. in coolant*			
Volume increase, %	+20 max.	+30	+18
Durometer change	-20 to +10	-12	-10
Tensile change, %	-20	-12	-6
Elong. change, %	-40	-38	-19

*Coolant is 1/3 each by volume of water, ethanol, and ethylene glycol.

adduct of polyisoprene is similar to its polybutadiene counterpart in being more compatible with SBR 1502 than natural rubber.

It should be pointed out that the "apparent" macro-compatibility of the adduct elastomers as judged by the ease of blending them with other rubbers on a mill is seemingly high for SBR, NR, nitrile rubbers, and other commercial materials. These compatibility data are a useful forewarning of trouble that may be encountered in adhering adduct elastomers to dissimilar rubbers, or in certain properties of stocks prepared from blends of the elastomers.

Typical End Use Applications

The very wide range of performance properties available in the adduct elastomers make them very attractive candidates for replacing or supplementing presently available "specialty" rubbers in a large variety of end products. Cited below are four representative cases of products where MeSH-BR adducts have offered promise of doing a job as well or better than has been possible by rubbers already in use.

Removable White Sidewall For Tires

Separately mountable white or pastel colored sidewalls have enjoyed a boom recently as a means of "converting" black sidewall tires at low cost. The rubber rings are held in place by a flange extending down between the tire bead and the wheel rim.

Since black tire sidewalls are usually compounded with dark staining oils which tend to diffuse through the demountable white walls, developing a satisfactory compound which is resistance to this stain transfer has been a major technical problem. By virtue of their resistance to diffusion to both large and small molecules, the adduct elastomers are well suited for use as partial replacements for the hydrocarbon rubbers usually employed.

Data illustrating the improvement gained by blending a 75% saturated adduct of polybutadiene and methyl mercaptan with hydrocarbon rubbers is shown below (both stocks contained 40 parts TiO₂, 50 parts CaCO₃, and 30 parts of clay per 100 parts total elastomer:

STAINING OF NR/ADDUCT VS. NR/SBR BLENDS

Composition	70/30 NR/SBR	70/30 NR/Adduct
	1800 psi./480%	1800 psi./450%
Tens./Elong. at opt. cure		
Stain resistance—12 hrs. in Weatherometer over staining compound—Rating (1 is best)	2	1
Exposed to weather on a Resiliometer over staining tire for approximately 2 weeks. Rating (1 is excellent, 10 is very poor)	6	2

Radiator Coolant Hose

There are many automotive applications where a performance specification has been slowly evolved which

*Society of Automotive Engineers, 29 W. 39th St., New York, N. Y.

tends to favor the use of a particular type of rubber. Radiator cooling hose, for example, is made in a number of grades, and one of these, SAE⁸ Specification 20R1, Class SC, is built around neoprene.

Inasmuch as the polybutadiene-methyl mercaptan adducts have, in general, greater solvent resistance than neoprene, advantage was taken of this property to use blends of adduct rubber with a hydrocarbon rubber to build a compound which would adequately serve the application. In the following comparisons of specifications with performance, 60 parts of carbon black was used (Table 15).

Impregnant for Airship Fabric

Major performance requirements for rubbers used in coating airship fabrics are diffusion resistance and age resistance. Nylon fabric coated with a 90% saturated MeSH-BR adduct elastomer has withstood aging tests well to date, although the tests have not yet been running long enough to determine how the fabric's lifetime would compare with neoprene coated nylon.

Hydrogen permeability tests on molded sheets of lightly loaded compounds (6 to 20 pts. MPC black) as used in airship type fabric have given the following results:

HYDROGEN PERMEABILITY TESTS

Elastomer	H ₂ Permeability 1/m ² /24 hr./mil
Adduct	17.8
Neoprene	37
Butyl	17.5

The lower density of the adduct polymer (approx. 1.07) gives it a considerable weight advantage over neoprene (density 1.25) in an application where weight savings are all-important. Incidentally, the reason butyl rubber is unsuited for this application is that the seams are cemented together with air curing cements.

Oil Resistant Foam for Railroad Journal Boxes

A major new use for oil resistant foam which is now looming is the introduction of foam rubber in place of wads of cotton to "hold" lubricating oil in place in railroad car journal boxes. Oil resistance, heat resistance, and retention of shape are the necessary properties for this application.

TABLE 16. ADDUCT VS. NEOPRENE FOAM RUBBER

	Adduct	Neoprene
Density (lbs./ft. ³)	8.1	10.5
Compression	Medium	Medium
	Range	Range
Dry Permanent Set, % (Retention of gage after 22 hrs. at 158° F. under 50% deflection)	95.0	95.0
Oil test (#10 Motor Oil) (a) % Swell after 24 hrs.	2.95	3.40
(b) Permanent Set, % (Retention of gage after 24 hrs. in oil at 230° F. under 25% deflection)	91.5	81.5

A conventionally prepared foam rubber sample, made from a 62% solids MeSH-BR adduct latex, has looked very promising in comparison with neoprene in tests which are being set up to screen rubber foams for this application (Table 16).

Status of Commercial Development

Recent introduction of the alcohol-hydrogen sulfide process for making mercaptans in the U. S. has enabled certain of the lower members to be offered at prices in the same range as many of the large volume monomers used for making presently available commercial rubbers. The manufacture of adduct elastomers, although somewhat similar in technology and equipment to that used for making SBR and like polymers, is sufficiently different to require substantial alterations in plant installations. The long range prospects for manufacture of many types of this versatile new family of elastomers at prices competitive with present high performance rubbers are considered very encouraging, however.

Our preparation experience with adduct rubbers has been carried into an advanced pilot plant stage, mostly on derivatives of methyl mercaptan. All polymer has so far been consumed in fabricating operations within our own company. The rubbers are not as yet being made in sufficient volume to be offered for outside sale or for sampling.

Acknowledgments

We wish to express our appreciation of the help received from many members of the Goodyear Research and Development Department. In particular we wish to acknowledge the continuous encouragement received from H. J. Osterhof and the helpful contributions of J. J. Hoesly.

WADC Evaluation of Polymers

(Continued from page 694)

come critical for the walls not cooled by liquid fuel. A fuel-cell test cube shown in Figure 22 has been fabricated through industry cooperation which shows considerable promise, not only from withstanding the effect of fuel and fuel vapor at high temperatures, but from permeability considerations as well.

Summary and Conclusions

We have made great stride toward matching the performance of rubber and air weapons, but we have not gained on the future—mostly just caught up to the present. To meet the goals which will be imposed upon us by the future, new elastomers will be needed. Wright Air Development Center will continue to conduct and sponsor research and development work on elastomers meeting air weapons requirements, and will continue to screen new polymers resulting both from this work and from independent development by industrial laboratories.

MEETINGS and REPORTS

Rubber Division, ACS, New York Meeting Plans; Goodyear Medal Award; Invited Paper on RMA

The fall meeting of the Division of Rubber Chemistry of the American Chemical Society will be held as a part of 132nd national meeting of the parent Society in New York, N. Y., during the week of September 9. The Rubber Division will hold its meeting September 11-13, at the Commodore Hotel. Special features of this Rubber Division meeting will be the presentation of the Charles Goodyear Medal of the Division for 1957 to Arthur Whiting Carpenter, consultant, and an invited paper to be presented by Ross R. Ormsby, president, Rubber Manufacturers Association, on the afternoon of September 12, entitled "Activities of the Rubber Manufacturers Association."

The technical sessions program consists of 25 papers and the first session will get under way at 2:00 p.m. on the afternoon of September 11, with B. S. Garvey, Pennsalt Manufacturing Co., Division chairman, presiding. The papers at this first session will deal mostly with compounding. At the second session on the morning of September 12, the papers will be mostly on the subjects of physical testing and analysis and R. F. Dunbrook, Firestone Tire & Rubber Co., Division vice chairman, will preside. The business meeting of the Division will be held at 11:00 a.m. during this session and Mr. Carpenter's Goodyear Medal Address, which he calls "The Tower of Babel," will be given at 11:15 a.m.

The papers to be presented at the third session on the afternoon of September 12 will discuss carbon black and polymers and J. D. D'Ianni, Goodyear Tire & Rubber Co., director-at-large of the Division, will be in charge of this session. The fourth and final session on the morning of September 13 includes outstanding papers on the subject of new polymers, Henry Peters, Bell Telephone Laboratories and chairman of the local committee on arrangements for this New York meeting, will preside.

For the benefit of early arrivals, there will be an opportunity to register from 4:00 to 9:00 p.m., Tuesday, September 10, at the Commodore Hotel, as well as on the remaining days of the meeting.

The 25 Year Club of the Division will hold its luncheon meeting at 12:30 p.m. on Wednesday, September 11, preceded by a get-together session starting at 11:30 a.m. W. O. Hamister, Naugatuck Chemical

Co. Division, U. S. Rubber Co., is the chairman for this New York 25 Year Club meeting, at which new members will be welcomed and the member with the longest record of service in the industry acclaimed.

The banquet on Thursday evening, September 12, will be highlighted by the Goodyear Medal Award presentation to Mr. Carpenter. Simon Collier, Johns-Manville Corp., will describe the Medalist and his accomplishments. A program of variety acts will conclude the banquet activities. A cooperative suppliers cocktail party will precede the banquet and C. A. Bartle, E. I. du Pont de Nemours & Co., Inc., is in charge of this affair.

In addition to Mr. Peters, H. J. Due, St. Joseph Lead Co., is vice chairman of the local committee on arrangements; Ralph DeTurk, Whittaker, Clark & Daniels, Inc., is in charge of program meeting rooms; George Vacca, Bell Telephone Laboratories is banquet chairman; Lester J. Koch, Weswood Chemical Co., Inc., finances; L. D. Carver, Witco Chemical Co., information; and R. G. Seaman, RUBBER WORLD, publicity.

Program and Abstracts of Papers

Wednesday Morning — September 11

9:00 a.m.—Registration.

11:30 a.m.—25-Year Club Luncheon Meeting. W. O. Hamister, chairman.

Wednesday Afternoon — September 11 Compounding

B. S. Garvey, Presiding

2:00 p.m.—1. Introductory remarks. B. S. Garvey.

2:05 p.m.—2. New Curing Systems and Curing Agents for Hypalon Synthetic Rubber. I. D. Roche¹ and W. J. Schrantz, Jr., Du Pont, Wilmington, Del.

This paper discusses the development of improved curing systems for Hypalon 20 (chlorosulfonated polyethylene) based solely on organic materials and completely free of metal compounds. The improved systems are based on combinations of sub-

stituted amines, substituted phenols, organic sulfides, and epoxy resins.

The organic curing systems afford a greater latitude in controlling rate and state of cure in Hypalon 20 compounds than has been known for metal oxide cures. In addition, the vulcanizate properties compare favorably with the best obtainable from the oxide-containing systems and in fact are superior in having inherently low modulus, high elongation, and low hardness. The water resistance of these stocks is markedly superior to that of magnesia cured vulcanizates, but somewhat inferior to that of litharge cured vulcanizates.

It is expected that the organic curing systems will permit the development of new Hypalon 20 products heretofore considered impractical.

2:30 p.m.—3. The Stabilization of Mineral Filled SBR Polymers against Surface Embrittlement. W. F. Abbey, R. T. Zimmerman, W. H. Cornell, R. T. Vanderbilt Co., New York, N. Y.

The use of SBR polymers in fast-curing, mineral filled recipes for the manufacture of light-colored articles has become a common practice in the rubber industry. Occasionally the surface of these articles becomes hard and brittle after some period of natural aging in service. They exhibit a lacquered appearance and crack when flexed.

This paper presents the results of an extended study of ways of preventing this surface embrittlement.

It has been found that this surface embrittlement can be produced in the laboratory by exposing test pieces in an oxygen bomb for seven days at 80° C. (300 psi. oxygen pressure).

It has been found also that the amine-type antioxidants are most effective in preventing this surface embrittlement.

Data are shown to indicate that the state of cure developed has an effect on the resistance to surface embrittlement.

2:55 p.m.—4. Flame Resistance of Neoprene—Effect of Compounding Ingredients. J. F. Hagman, N. N. Mueller, D. C. Thompson, Du Pont.

The resistance of neoprene and other halogen bearing polymers to flame propagation has been amply demonstrated. An observation of the length of time a sample

¹ Names in bold face type indicate person presenting paper.

burns after removal of a flame source and the portion of the sample not consumed gives a qualitative measure of flame resistance. It is known that compounding ingredients have a pronounced effect on the flame resistance of all elastomers, but the tests formerly employed have been so lacking in reproducibility that conclusions on the relative merits of various compositions have had limited significance.

For the study reported in this paper an apparatus was developed from which reproducible measurements of resistance to flammability were obtained, and indices applied to the compounds tested. Radiant heat from an electric arc is focused by two parabolic reflectors on to a small area of the test specimen. Temperature is controlled by light filters. The following measurements are taken: kindling temperature of specimen, kindling temperature of gases of decomposition, combustion time, time to extinguish, and degree of flame propagation.

Loading, in general, increases the flame resistance of neoprene, but there are substantial differences among the various types of fillers. Even among the carbon blacks great differences exist in their effect on flame resistance. There appears to be no correlation with particle size.

Plasticizers, in general, have an adverse effect on flame resistance. This is true even for those which are themselves flame resistant, except for certain liquid, chlorinated paraffins.

3:15 p.m.—5. Higher Alkyl or Aryl Salts of Dithiocarbamic Acid as Improved Accelerators for Butyl Rubber. W. F. Fischer, R. F. Neu, R. L. Zapp, Enjay Co. Laboratories, Linden, N. J.

Laboratory investigations and field service performance data have indicated that the ozone and weathering resistance of steam-cured butyl vulcanizates is at a lower level than would be predicated on the basis of tests on press-cured test slabs. Studies of thin films have indicated that this phenomenon can best be explained on the basis of a reduced state of surface cure caused by hydrolysis of conventional butyl accelerators in open steam. Use of this thin-film technique also established the promise offered by higher molecular weight salts of dithiocarbamic acid as hydrolysis resistant accelerators.

Many such accelerators have been screened in typical butyl extrusion compounds covering a range of hardness values. The improvements offered by these materials have been confirmed in high ozone concentrations (0.2 volume %), low concentrations (50 pphm.), and in outdoor weathering tests. In addition to work with standard ASTM² test pieces, data obtained with automotive weatherstrips appliance hose, and electrical insulation compounds are reported. The most promising of the new accelerators have been successfully run in factory trials.

Combinations of these new accelerators with conventional butyl accelerators offer still further improvements in product quality, particularly from the standpoint of ozone resistance.

Cost compounding studies are also presented.

3:45 p.m.—6. Butyl Latex Tire-Cord Adhesives. Alfred L. Miller and Samuel B. Robison, Esso Research & Engineering Co., Linden, N. J.

The development of a butyl latex tire-cord adhesive system has made an important contribution to a successful butyl tire. Because of the unusual relations that exist between the chemical and physical properties of butyl rubber and those of the principal high unsaturation rubbers, an examination has been made of the chemistry of cord adhesives, the variables involved in their application to cord fabrics, and the significance of laboratory test values for the butyl system in terms of tire performance. This work has led to some interesting observations and results which will be described in this paper.

Based on an examination of the chemistry of RFL³ cord adhesive systems, it is conceived that three competitive reactions are involved, and improved control of these reactions can result in an increase in adhesion. Microscopic examination of surfaces and cross-sections of treated cord has indicated that the amount of dip pick-up and its location can contribute to improved adhesion. It will be shown that control of these variables can be obtained by proper use of squeeze roll pressure. Analysis of the "H" adhesion test's⁴ relation to tire performance has raised several questions which will be discussed in this paper in conjunction with our observations on the mechanism of adhesion failure.

The best evaluation of cord adhesion is tire performance on the road and on the indoor test wheels. A discussion of the role cord adhesion may play accompanied by performance data for butyl rubber tires will be included in this paper.

4:10 p.m.—7. Compounding of Silicone Rubber—V. F. L. Kilbourne, Jr., A. S. Kidwell, R. D. Alling, Z. J. Grabicki. The Connecticut Hard Rubber Co., New Haven, Conn.

Five years of experimental work is summarized, leading to the development of high tensile, high tear strength silicone rubber compounds. The compounds have seen considerable use in the aircraft industry, where their unusual combination of properties makes them particularly suitable for airframe sealing applications.

The compounding of high strength silicone rubber is discussed briefly, and compounding using alkoxy-coated silica is covered in detail. Criteria for the selection of silicone gums, especially extreme low-temperature gums, and for specification of the coated filler are included.

The selection and the use of antioxidants, and compatible vulcanization systems, including dithiocarbamates and certain peroxides, are also discussed. Combinations of various ingredients and methods are described which made it possible to obtain the high tensile strength, excellent tear resistance, 400° F. heat stability, and resistance to ASTM No. 1

oil⁵ itemized in AMS 3345-46 specifications.⁶

The use of statistical experimental design is illustrated, and some discussion of theory of reinforcement and vulcanization of silicone rubber is included.

4:35 p.m.—8. Silicone Rubber Reclaim. B. R. Wendrow, U. S. Rubber Reclaiming Co., Inc., Buffalo, N. Y., and D. P. Spalding, General Electric Co., Waterford, N. Y.

While cured silicone rubber has been successfully reclaimed and reused for several years, little information on the process and the product has been published. Silicone rubber can be reclaimed by either a wet or dry process. The wet process gives the most reliable and reproducible results and has been perfected on a commercial basis.

This paper includes the results of testing of wet process reclaim of all of the major classes of silicone rubber such as: general-purpose, extreme low compression set, extreme low temperature, and extreme high temperature. These classes include all the major types of silicone gums and recommended reinforcing fillers.

The paper reports the effect on the cured physical properties of the various classes of virgin silicone rubber caused by the incorporation of various levels of reclaim. Some unusual effects are noted. The effect on the processing characteristics of the same blends is also reported. Recommendations for optimum level of reclaim use and proper quantities of additional curing systems are also made.

Thursday Morning—September 12
Physical Testing and Analysis
R. F. Dunbrook, Presiding

9:00 a.m.—9. The Determination of Bound Styrene in Raw and Cured Polymers by Nitration. C. L. Hilton, J. E. Newell, J. Tolsma, United States Rubber Co., Research Center, Wayne, N. J.

Although there are several methods for the determination of combined styrene in styrene-butadiene copolymers, a method was needed which would be applicable to a wider variety of samples.

Perhaps the most widely used method for determining the bound styrene in raw SBR has been the refractive index procedure. While this method is excellent as a control method, the results obtained are influenced by the temperature of polymerization.

The infrared and ultra-violet absorption techniques are not generally applicable to cured stocks because of the difficulty in separating the polymer in a soluble form from all interfering substances in the stock.

The present paper describes the quantitative determination of bound styrene in raw and cured stocks by nitration and oxidation of the polymer. The p-nitrobenzoic acid obtained is separated from other materials by liquid-liquid extraction. The styrene content is then determined from the ultra-violet absorption spectrum.

The accuracy and the precision of the method over a wide variety of samples have been excellent.

A modified procedure eliminating the several extraction steps is also described. The modified method is applicable where

² American Society for Testing Materials, Philadelphia, Pa.

³ Resorcinol-formaldehyde latex.

⁴ RUBBER WORLD, May, 1946, p. 213.

⁵ ASTM D 471-55T.

⁶ Society of Automotive Engineers, 29 W. 39th St., New York, N. Y.

⁷ Present address: United States Rubber Co., Naugatuck Chemical Division, Naugatuck, Conn.

results within 2% or 3% (absolute) of the true styrene content are satisfactory.

9:25 a.m.—10. Near Infrared Studies—Rate Constants for the Alcohol/Aryl Isocyanate Reaction. I. C. Kogon, Du Pont, Contribution No. 246.

A new technique has been developed utilizing the near infrared (IR) spectrum for obtaining rate data for the alcohol/aryl isocyanate reaction. The technique is a reliable method for determining the relative rates of carbamate formation. Second-order rate constants for the triethylamine catalyzed and uncatalyzed reaction of ethyl alcohol with aryl isocyanates have been determined at 28° C.

For the uncatalyzed reaction the order of reactivity of several aryl isocyanates with ethyl alcohol is phenyl > *p*-tolyl > *o*-tolyl. For the triethylamine catalyzed reaction the order of reactivity of several aryl isocyanates with ethyl alcohol is 4-isocyanate group of tolylene 2,4-diisocyanate > phenylisocyanate = first isocyanate group of tolylene 2,6-diisocyanate. The electron attracting activating effect of a meta isocyanate group increases the rate of reaction by a factor of approximately 8.

9:40 a.m.—11. Mooney Viscometer Studies as Related to Molded Electrical Products. A. A. Kessel, General Electric, West Lyme, Mass.

In the injection molding of electrical apparatus with elastomeric materials, the components are positioned within a mold, and the elastomer is then forced into the mold cavity. It is essential that the force of the material on the parts during the fill operation be controlled to prevent displacement and thus insure adequate thicknesses of insulation between the components.

Previous work by M. Mooney has shown that the Mooney viscometer gives a measurement of plasticity of an unvulcanized rubber. The Mooney data are normally used for quality control testing and evaluating new compounds that will conform to established specifications. This paper discusses a method of correlating the Mooney data with the parameters of injection molding.

By using Mooney's original derivations and the author's data obtained on stocks of mineral loaded butyl rubber, equations and curves are developed showing the relations between the rate of fill, stock temperature, Mooney plasticity, and the force applied to the insert during the molding process. The curves are then combined into a nomograph at a critical force. By simply determining the Mooney plasticity of an unknown stock, the optimum fill rate and the temperature can be obtained from the nomograph.

10:00 a.m.—12. Measurement of the Closed-Cell Content of Cellular Materials. W. J. Remington and R. Pariser, Du Pont.

An apparatus and procedure are described for determining the volume percentage of closed cells in a cellular material. The apparatus may be used to measure either rigid or flexible foams. It operates on the principle of Boyle's law and involves the measurement of the volume of displaced air which results when a specimen of foam is placed in the sample

chamber. The volume of displaced air represents the space occupied by the closed cells plus the cell walls of a foam. After correcting for space occupied by the cell walls, the closed-cell content may be expressed as a percentage of the total foam volume.

The test has been applied to rubber, vinyl, and polystyrene, as well as to urethane foams.

10:25 a.m.—13. Accelerated Ozone Aging Tests. R. R. Phelan, Enjay Labs.

It is generally recognized that ozone is the main factor that causes severe weather aging of elastomer compounds. In order to suggest an accelerated ozone test which can most accurately predict weathering performance of one polymer compared to another, a broad ozone concentration range was investigated. The study was further expanded in order to investigate the many testing variables which influence the ozone resistance of rubber vulcanizates. Natural rubber (NR), styrene-butadiene rubber (SBR), neoprene rubber (CR), and butyl rubber (IIR) were the polymers studied; these materials ranged in unsaturation values from less than 1% to 100%. Each polymer was compounded with 50 phr. of EPC carbon black which does not necessarily give optimum ozone resistance.

The effects of the following factors on ozone resistance are discussed: (1) temperature of test; (2) stress of vulcanizates; (3) ozone concentration; (4) polymer molecular weight; (5) presence of nitrous oxide and organic vapors. Changes in any of these testing variables do not markedly affect the relative ranking of one polymer to another. NR and SBR always rank poorest from the standpoint of ozone resistance, while IIR ranks best. The rate of change of apparent ozone resistance of a given polymer with changes in the testing variables, however, is a function of the polymer being tested. Thus the testing conditions employed do affect the magnitude of the differences in ozone resistance between polymers.

From the results of this work an ozone test is suggested which can most accurately predict weathering performance of one polymer compared to another.

11:00 a.m.—Business Meeting.

11:15 a.m.—14. "The Tower of Babel." Arthur Whiting Carpenter, Goodyear Medal Address.

Thursday Afternoon—September 12
Carbon Black and Polymers
J. D. D'Ianni, Presiding

2:00 p.m.—15. The Determination of Discoloration of Rubber-Like Films by Reflectance Spectrometry. James T. Hill and Fred Leonard, Walter Reed Army Medical Center, Washington, D. C.

In the course of an investigation of rubber-like films such as synthetic acrylate elastomers and plasticized polyvinyl chloride (PVC) for use in cosmetic gloves for amputees, it became of interest to develop methods for determining the resistance of the films to staining and yellowing.

The method developed consisted in

⁸ Beckman Instruments, Inc., South Pasadena, Calif.

measuring the spectral reflectance curves between 400 mμ and 700 mμ with a Beckman spectrophotometer,⁸ of an unstained sample, a stained sample, and the stained sample after attempts had been made to remove the stain. The % stain resistance was expressed as the following ratio

$$\% \text{ SR} = \frac{\sum_{400 \text{ m}\mu}^{700 \text{ m}\mu} (R_i - R_{00})}{\sum_{400 \text{ m}\mu}^{700 \text{ m}\mu} (R_i - R_{00})}$$

where the numerator represents the area between the spectral reflectance curves of the unstained sample and the sample from which attempts had been made to remove the stain, and the denominator represents the area between the spectral reflectance of the unstained sample and the stained sample.

A similar method was used to determine the % yellowing. In this instance the standard yellow sample was that yellow developed by a sample of PVC heated at 170° C. for a period of time just less than that required for brown spots to appear. The dominant wave length, brightness, and purity of this standard yellow based on ICI Illuminant C was 578 mμ, 38.7% and 74.0%, respectively.

The method is consistent with visual observations and has the advantage of permitting the effects to be described quantitatively.

The technique is potentially useful in studying those variables which affect the color of elastomers such as the effect of stainants, stabilizers, heat, and light.

2:25 p.m.—16. Invited paper—Activities of the Rubber Manufacturers Association. Ross R. Ormsby, The Rubber Manufacturers Association, Inc., New York.

2:50 p.m.—17. The Absorption Spectrum of Carbon Black Dispersions in Mineral Oil. Andries Voat, J. M. Huber Corp., Borger, Tex.

The light transmission of very dilute dispersions of carbon black in mineral oil was investigated in the range from 2300-2400 Å. It appears that the Lamber-Beer Law is accurately followed in the concentration range investigated, 0.001-0.01% by weight.

All carbon black dispersions show similarities in their spectral curves, with straight or slightly curved lines down to 2840 Å and marked minima and peaks in lower ultra-violet range. There are, however, striking differences characteristic of the type of black. Thus color blacks are easily identified from spectral curves. Carbon blacks usually referred to as structure blacks have a characteristic ultra-violet absorption. In addition, the surface area of the black can be directly related to the absorbance of the dispersion.

The scattering coefficient, as calculated from the transmission data, is smaller than unity, in agreement with conclusions drawn from electrical measurements indicating that the dispersed particles are larger aggregates of the elementary particles.

3:15 p.m.—18. The Chemistry of Rein-

forcement—V. A. Study of TMTD Sulfurless) Vulcanizates Containing Carbon Black. Merton L. Studebaker and Lester G. Nabors, Phillips Chemical Co., Akron, O.

A series of natural rubber vulcanizates was prepared which contained various types of carbon black. Tetramethylthiuramdisulfide (TMTD) was used as the curing agent. The cured samples were "devulcanized" by treatment with air in boiling *o*-dichlorobenzene, and the carbon black was removed by filtration. Ultimate analyses of the carbon black fractions and the rubber fractions and cross-linking measurements on the original vulcanizates permit certain conclusions to be made regarding vulcanization by TMTD in the presence of carbon black.

The carbon blacks are shown to increase the cross-linking efficiency of the curing agent. Some of the sulfur added as TMTD remains in the carbon black fractions and is not available to form the cross-links which are measured by the swelling procedure. Aside from the sulfur so removed, approximately eight sulfur atoms (two molecules of TMTD) must be added to the stock to produce one cross-link.

3:40 p.m.—19. Halogenation of Butyl Rubber Using Iodine Monochloride and Iodine Monobromide. R. T. Morrissey, The B. F. Goodrich Research Center, Brecksville, O.

Bromination of butyl rubber has produced a polymer having several properties superior to butyl itself. Among these improvements are better covalcanization with natural rubber and SBR and increased adhesion to other elastomers and metals. Further study has been made of the products made by the reaction of other halogens with butyl rubber.

The effectiveness of the different halogens in modifying butyl rubber can be summarized conveniently in the following scale: $BR \gg Cl > F \gg I$.

The combination of bromine or chlorine with iodine in the form of iodine monobromide or iodine monochloride has modified butyl rubber in nearly the same manner as bromine alone. This discovery is of special interest in view of the fact that iodine and chlorine alone have yielded products inferior to brominated butyl.

The halogenation reaction involves mainly addition to the double bonds of the isoprene units. This is substantiated by the fact that the mole % unsaturation of butyl decreases as a linear function of the moles of halogen present in the polymer.

Studies of the reaction of I Br and I Cl with butyl rubber have shown that only a portion of the iodine remains in the halogenated polymer. In these reactions some of the iodine is believed to split out as hydroiodic acid. The iodine remaining in the polymer probably takes part in a metal oxide cure of the polymer.

4:05 p.m.—20. Effect of Catalysts of Urethane Foam Properties. B. G. Alzner and Kurt C. Frisch, Wyandotte Chemical Corp., Wyandotte, Mich.

Physical properties of flexible polyether-diisocyanate foam made with six different

catalysts are compared. Two catalysts derived from piperazine, N,N'-bis-(2 hydroxypropyl)-2 methylpiperazine and N,N'-diethyl-2 methylpiperazine, and N-(2 hydroxypropyl)-dimethyl morpholine have a low odor level. The other three catalysts, N-methyl morpholine, triethylamine and dimethylaminoethanol, are recommended in the literature for preparation of urethane foams.

Foaming rate, curing rate, foam density, shrinkage, compression-deflection values, compression set, resilience, tensile and tear strengths are compared and discussed in the light of the chemical nature of the catalysts. Physical test data showing use of the catalysts in making a typical cushion grade urethane foam are given.

Information provided may be utilized in selecting a catalyst to produce foams of desired physical properties and softness. It is shown that faster gelling catalysts result in softer foams of lower density than slower gelling ones. The foam properties from the slow and fast gelling catalysts may be combined in varying degrees by the combined use of two such compounds. Odorless foams made with piperazine-type catalysts are comparable in most physical properties to odor-bearing foams made with the catalysts recommended in the literature.

Friday Morning—September 13
New Polymers
Henry Peters, Presiding

9:00 a.m.—21. New Fusible Silicone Rubber Compounds. F. Fekete and J. H. Lorenz, Union Carbide Corp., Silicones Division, Tonawanda, N. Y.

A new family of recently developed silicone rubber compounds offers distinct advantages in the electronic field. These compounds, fabricated and cured by conventional means, have the unique property of fusing together when pressed or wrapped under slight tension; heating at moderate temperatures accelerates the fusing into a homogeneous mass. In addition, these compounds exhibit a building tack such that they will stick to themselves immediately upon application. Thus no pressure binding or molds are needed for the final cure.

The fusible compounds show excellent physical and electrical properties; they may be calendered, extruded, or solvent dispersed for dip coating. Besides fusing to themselves or other silicone rubber compounds, these materials show promise for improving bonds of silicone rubber to fabrics and metals.

The insulating class of the fusible compounds shows excellent resistance to reversion, good heat stability, and high tear strength. This class, which on glass cloth exceeds existing military specifications for silicone rubber tapes, has proved useful in cable wrapping; other wrapped articles, such as hot air ducts, can easily be fabricated.

A second class of fusible compounds is electrically conductive, with a resistivity in the range of 1 to 2 ohm-cm. This material has utility as a heat source; fusible compounds with intermediate resistivities, obtained by blending of compounds, show promise as corona precipitators.

This new family of silicone rubber com-

pounds is sure to have application wherever bonding of silicone rubber to rubber, metal, or fabric is a problem.

9:25 a.m.—22. A Solvent Resistant Fluorosilicone Rubber. T. D. Talcott, E. D. Brown, and G. W. Holbrook, Dow Corning Corp., Midland, Mich.

Rapidly advancing aircraft and industrial developments have extended the temperature requirements of solvent resistant elastomers. Much interest has therefore developed in a new fluorosilicone rubber which combines the excellent high-temperature characteristics typical of silicone rubber with excellent solvent and oil resistance.

This paper discusses the properties of fluorosilicone rubber and their effect upon intended applications. Included are physical properties, low-temperature characteristics, and the effect of aging at elevated temperatures. Emphasis is placed upon the resistance to various types of solvents and oils and the effects of both time and temperature of immersion. Data on modifications are included. Blending with other polysiloxanes provides elastomers with special solvent and oil resistant characteristics. The effect of both fillers and vulcanizing agents is discussed.

Many applications for silicone rubber have been hindered by the lack of resistance to certain oils and solvents. This new elastomer shows promise for use in many of these potential applications.

9:50 a.m.—23. Polyurethane VC, a Virtually Cross-Linked Elastomer. C. S. Schollenberger, H. Scott, G. R. Moore, Goodrich Research Center.

Many of the outstanding physical properties that characterize elastomeric polyurethanes have been realized in a soluble, thermoplastic variety, Polyurethane VC, which displays the superficial properties of a rubbery vulcanizate at room temperature and so is considered to be virtually cross-linked.

High tensile strength as well as good tear, abrasion, solvent, oil, and ozone resistance characterizes this polymer. Since these properties are realized in the unvulcanized state, many useful applications of the readily processable polymer can be made avoiding the complications which attend the use of conventional (vulcanizing) urethane elastomers.

Studies of the adaptation of Polyurethane VC as an outer jacket for WD-1 (infantry field communication) wire on a contract with the U. S. Army Signal Corps demonstrated a deficiency in the weather resistance of the raw polymer. Weather-induced changes, believed to be due to ultra-violet-initiated autoxidation, have been estimated by noting changes in the stress-strain properties as well as the ultra-violet and infrared absorption spectra of the polymer on exposure to natural and artificial weather conditions.

The beneficial effects of certain carbon blacks, conventional antioxidants and ultra-violet absorbers on the weather resistance of the polymer are described.

10:15 a.m.—24. Alkyl lithium Polymerization of Isoprene. C. F. Gibbs, Hugh E. Diem, Harold Tucker, Goodrich Research Center.

A study of the alkyl lithium polymerization of isoprene has shown the following characteristics:

(1) Conversion increases linearly with time, either in bulk or solution, up to the point where increased viscosity has reduced the monomer diffusion rate.

(2) The molecular weight is directly proportional to the conversion.

(3) Induction periods are either brief or non-existent.

(4) The polymer produced, except as noted below, is largely a *cis*-1, 4-polyisoprene, together with a small amount of 3,4-polymer. The amount of 3,4-structure is independent of the conversion. It is, however, dependent upon the effective catalyst concentration, upon the solvent, and upon the polymerization temperature. At a given effective catalyst concentration, polymerization in aromatic solvents gives more 3,4-structure, and polymerization in aliphatic solvents less 3,4-structure, than is obtained for bulk polymerization.

(5) The polymerization is sensitive to oxygenated impurities, and compounds with active hydrogen, such as oxygen, carbon monoxide, carbon dioxide, amines, ethers, and certain unsaturated hydrocarbons. Most of these impurities stop the polymerization.

(6) The other class of impurity changes the course of the polymerization, rather than stopping it, to give a polymer with a high amount of 3,4-structure. Even as little of various ethers as half the molar amount of the alkyl lithium serves to alter substantially the structure of the resulting polymer.

(7) Generally the isoprene and hydrocarbon solvent must be carefully purified, and the polymerization conducted with rigorous exclusion of moisture and oxygen. Catalyst requirements may be as low as 0.05-millimole of alkyl lithium per mole of monomer. A number of various alkyls are suitable.

(8) Alkyl lithiums offer some advantages and encounter some disadvantages when compared to lithium as polymerization catalysts.

10:40 a.m.—25. *Cis*-1,4 Polyisoprene Prepared with Alkyl Aluminum and Titanium Tetrachloride. H. E. Adams, R. S. Stearns, W. A. Smith, J. L. Binder, The Firestone Tire & Rubber Co., Akron.

The alkyls of aluminum have been used with titanium tetrachloride to catalyze the polymerization of isoprene. By the proper adjustment of the relative amounts of the two components of the catalyst and the temperature of polymerization, it is possible to form *cis*-1,4 polyisoprene free from the *trans*-1,4 configuration. Catalysts containing a 1.0:1.0 mole ratio of alkyl aluminum to titanium tetrachloride will produce polymers of this configuration upon polymerization at room temperature. If the temperature of polymerization is lowered, somewhat higher ratios are needed to achieve the same result.

Catalyst levels of three to five parts per hundred monomer of total catalyst are required to obtain 100% yield in four hours at room temperature. Solution polymerization was used to control the reaction and obtain a uniform product. The inherent viscosities of the polymers made

under these conditions are quite low, usually 2.0 to 2.5. Higher molecular weight polymers, however, are produced if the polymerization temperature is lowered.

Compounding studies indicate that vulcanizates of these polymers possess gum tensile properties quite comparable to those of natural rubber. Hysteretic properties of the carbon black vulcanizates of the polymers that have been prepared are inferior to those of natural rubber.

11:05 a.m.—26. Low-Temperature Properties of 80% *Cis*-Polybutadiene. H. E. Railsback and Q. L. Morris, Phillips Petroleum Co., Bartlesville, Okla.

Polybutadiene rubbers have been found to display excellent freeze resistance when the *cis* configuration is in the range of 80%. The outstanding freeze resistance observed (Gehman freeze points as low as -100°C .) made a comprehensive study of the low-temperature characteristics of rubbers of this type mandatory. It was realized that reliable predictions of Arctic service performance from laboratory tests would be difficult. Particular attention was therefore given to tests designed to give the most reliable indication of both first- and second-order transition.

The rubber selected for study had a Mooney viscosity (ML-4 at 212°F .) of 18. The configuration was 78.6% *cis*, 16.6% *trans*, and 4.8% vinyl. Tests performed included Gehman freeze point, rate of retraction, cold compression set, resilience, and Shore hardness; properties were determined at test temperatures as low as -115°C . and conditioning times up to 70 hours.

The 80% *cis* polymer gave a Gehman freeze point of -97°C . (SBR 1500, -52°C .; natural rubber, -61°C .) and less tendency to crystallize (first-order transition) than natural rubber or emulsion polybutadiene, under the conditions used. The 80% *cis* rubber gave much softer and more elastic stocks at low temperature than any of the controls. Polybutadienes of this structural configuration display stress-strain properties similar to emulsion polymerized polybutadiene and hysteresis properties equivalent to natural rubber. Although not now commercially available, this type of polymer should prove to be useful in general applications and to be outstanding for low-temperature service.

Tlargo Sets Up Memorial Fund Scholarship at USC

In memory of the late R. D. Abbott, chairman of The Los Angeles Rubber Group, Inc., when the Tlargo Foundation was established at the University of Southern California, the first annual Tlargo Memorial Fund scholarship will be awarded at USC this fall.

The Memorial Fund was started by the Foundation, which is a joint effort of Tlargo and USC, two years ago when its officers decided to suggest memorial gifts rather than flowers when Tlargo members or members of their families died. Bob Abbott was instrumental in setting up the Fund. More than \$5,000 has been con-

tributed to date. Income from this money will be used to provide a \$500 scholarship award each academic year at USC.

Recipient of the first scholarship will be Charles Pierce Bopp, a senior and chemical engineering major in the USC School of Engineering. He was selected by the Foundation's advisory board from candidates recommended by the School of Engineering.

Chemical Show Committee

E. R. Weidlein, trustee of the Mellon Institute, has been named chairman of the advisory committee for the twenty-sixth Chemical Exposition of Chemical Industries, which will be held in the Coliseum, New York, N. Y., December 2-6, according to International Exposition Co., New York, manager of the event.

Other members of the advisory committee follow: Roger Adams, University of Illinois; William S. Auchincloss, *Oil Paint & Drug Reporter*; J. V. N. Dorr, Dorr-Oliver, Inc.; R. P. Genereaux, E. I. du Pont de Nemours & Co., Inc.; Norman Hackerman, Electrochemical Society; Raphael Katzen, chemical engineer; Sidney D. Kirkpatrick, *Chemical Engineering and Chemical Week*; Walter E. Lobo, M. W. Kellogg Co.; Robert B. MacMullin, R. B. MacMullin Associates.

Also Walter J. Murphy, *Industrial and Engineering Chemistry*; W. T. Read, general staff, Department of the Army; Vincent L. Rebak, Salesmen's Association of American Chemical Industry, Inc.; J. Henry Rushton, American Institute of Chemical Engineers; N. A. Shepard, Consultant; Julian C. Smith, Cornell University; L. V. Steck, the Chemist's Club; E. K. Stevens, International Exposition Co.; R. Gordon Walker, consultant; Roger J. Williams, American Chemical Society.

SRG Connell Scholarship

The first educational project of the new Southern Rubber Group has been to establish a scholarship to honor the memory of Harmon "Red" Connell, who did a lion's share of the work in organizing this Group and was elected the first chairman at the organizational meeting in November 1956. He has been missed by all since his untimely death earlier this year.

The scholarship has been established at Mississippi State College, Red's Alma Mater, and is known as the "The Harmon Connell Memorial Scholarship." The recipient must be a senior in either chemistry or chemical engineering and the award, which amounts to \$500 towards expenses during the school year, will be made on the basis of scholarship and need.

The scholarship award for the school year 1957-58 has been made to Leslie R. Drane, Jr., of Mayhew, Miss. The Group expresses the hope that this scholarship will stimulate interest in rubber technology in the South.

Goodrich's Craig Speaks At Thiokol Club Meeting

David Craig, The B. F. Goodrich Co., Akron, O., was the guest speaker at the July 3 meeting of the Thiokol Technical Club held on Thiokol Chemical Corp.'s Trenton, N. J., plant grounds, July 3.

Discussing "Vulcanization" before a post-dinner audience of 200, Dr. Craig said he viewed vulcanization as a process consisting of a cross-linkage reaction and a degradation or reversion reaction, where even in the initial stages of vulcanization the reversion step occurs, contrary to prevailing views.

Interpreting the vulcanization process in terms of these fundamental competitive reactions, Dr. Craig gave a schematic explanation of his version of the controversial two-step theory of vulcanization.

The Goodrich researcher was introduced by E. M. Fettes, Thiokol's manager of research and development. Attending the meeting was J. C. Patrick, one of the pioneers in synthetic rubber research in this country and a developer of polysulfide polymers.



David Craig, extreme left, Thiokol Technical Club's guest speaker, chats across table with B. C. Barton, Texas-U. S. Chemical Corp., second from right. Also seated are Eugene Bertozzi, Thiokol section head, second from left, and Walter Nudenberg, Texas-U.S., extreme right. Standing is E. M. Fettes, Thiokol's manager of research and development

Progress in Coral Rubber; Foreign Patents Granted

The Firestone Tire & Rubber Co., Akron, O., which described the technical details of its process for producing synthetic *cis*, 1,4 polyisoprene called Coral rubber before the Division of Rubber Chemistry of the American Chemical Society in November, 1955,¹ recently summed up the progress in the production and use of this synthetic natural rubber.

At the same time, Firestone announced that it has been granted patents in two foreign countries on methods for producing Coral rubber. The patent numbers are as follows: Italy, 559,160, 559,704, 560,200, 561,343, and 561,529; and Spain, 230,655, 231,396, and 231,397. These patents, together with more than 70 additional patent applications filed in the United States and in other foreign countries, involve mass and solution polymerization techniques.

Advantages enumerated for the Firestone process included not only the production of a high-quality, high molecular weight rubber, which consistently gives less heat build-up than natural rubber in products such as tires, but also the excellent degree of reproducibility of the process.

In addition to 14.00 by 24 military Coral rubber tires which have been said by the U. S. Army Ordnance to be equivalent to military tires of natural rubber, 24.00 by 25 military tires, more than six feet in diameter and weighing about 1,000 pounds, are being made. No major processing difficulties were reported in the manufacture of these larger-size tires.

Firestone says that it is satisfied that Coral rubber may be used in any application where natural rubber is now used.

and that this fact will be quite important from an economic viewpoint in a few years when the predicted shortage of natural rubber occurs.

Enlarged pilot-plant facilities are being installed in Akron to increase Coral rubber production.

New York Course Slated

The New York Rubber Group will give a 15-lecture course in "Basic Elastomer Technology" at the Engineering Societies Building, 29 W. 39th St., New York, N. Y., each Monday from 7:30 to 9:45 p.m., October 7 to February 3, 1958.

Registration has been limited to the first 200 applications received, according to L. C. Komar, Titanium Pigment Corp., chairman of the Group's educational committee. Applications for registration will be mailed to the organization's membership during September.

The course will deal with the history, economics, chemistry, and technology of natural and synthetic rubbers, as well as polyethylene, PVC, and rubber-to-metal bonding.

Ontario Group Formed

The Ontario Rubber Section of the Chemical Institute of Canada will become a separate, self-governing group, affiliated with the Rubber Division of the Chemical Institute of Canada, on September 1. The new organization will be known as The Ontario Rubber Group.

Slate Furniture Exhibit

The twenty ninth annual convention of the National Association of Furniture Manufacturers will be held at the Conrad Hilton Hotel, Chicago, Ill., August 25-28, simultaneously with the third annual NAFM Supply, Equipment & Fabric Fair. Rubber companies expected to exhibit include Dryden Rubber Division of Sheller Mfg. Corp., Keokuk, Iowa; United States Rubber Co., New York, N. Y.; and Textileleather Division of the General Tire & Rubber Co., Toledo, O.

Dryden will show polyester and polyether urethane foams for use in back, arm, and seat cushions, as well as molded bolster and sleep-sofa units. U. S. Rubber will have exhibit Us-Kon electric heating blankets for heat-curing of glues and adhesives and for warming vinyl upholstery for improved fitting. General Tire will introduce a new "Holiday" color line of leather-like materials.

SPE Polyethylene Confab

A regional technical conference on "Polyethylenes—Properties and Uses" will be sponsored by the Cleveland-Akron section of the Society of Plastics Engineers, at the Hotel Carter, Cleveland, O., October 17.

Representatives of material suppliers during the morning session will present papers comparing the properties of the various density polyethylenes. New uses for the polyethylenes will be described by the major processors during the afternoon session.

Registration information may be obtained from E. J. Haskins, in care of Zenith Plastics Co., 1009 Rockwell Ave., Cleveland 14, O.

¹RUBBER WORLD, Oct., 1955, p.83; July, 1956, p. 549.

NEWS of the MONTH

Washington Report and National News Summary

... The "Second Report of the Attorney General on Competition in the Synthetic Rubber Industry," issued on July 1, approved the progress of competition in this industry, with only minor reservations. Most significant developments during the past year were considered to be the increases in copolymer and in butadiene capacity and the potential entry of a new producer for butyl rubber. SBR price rigidity was the cause of some concern.

... The International Rubber Study Group estimates a new rubber consumption record of 3,170,000 long

tons will be set in 1957, but that a deficit of 35,000 tons of natural rubber will occur.

... According to the latest report of the U. S. Tariff Commission, output and sales of rubber chemicals in 1956 were lower than in 1955 because of the lower rubber consumption last year.

... The wage increase pattern for the rubber industry was probably set on July 22 when The Goodyear Tire & Rubber Co. signed an agreement with the United Rubber Workers for a 14.5¢-an-hour wage increase.

Washington Report

By ROBERT E. L. ADAMSON

Justice Department Approves Progress of Competition in Synthetic Rubber, with Only Minor Reservations

Attorney General Herbert Brownell, Jr., in July gave the synthetic rubber industry the closest thing to a clean bill of health a government anti-trust official could expect to give it in reporting to Congress in his second report on "Competition in the Synthetic Rubber Industry," dated July 1. At the end of a comprehensive 32-page study of the industry some 20 months after it took over most of the government's war-built plants, Brownell came up with this only slightly hedged conclusion:

"In sum, the synthetic rubber industry gives indications that a fully competitive status is slowly emerging, although there remain some factors of concern. On balance, however, I believe that the 1956 developments in this industry on the whole reflect a favorable progress toward the ultimate goal of the (1953) Disposal Act, development of a 'free, competitive, synthetic rubber industry.'"

Specifically, the Attorney General said there were three "factors of concern":

1. The "persistent stability and uniformity" of GR-S prices, evidencing to him and his anti-trust aides "an incomplete development of competition.

"Thus, in the entire period of private ownership, GR-S prices have been relatively unresponsive to changes in market conditions. The only price movement, that in June, 1956, appears to have been more of a readjustment in the general price structure by producers than a response to the softening in demand.

"While price rigidity and price uniformity may be among the characteristics of a market not effectively competitive, there have here been some indications of rivalry based on service, quality, and similar inducements. In any event, the full effect of the expansion of capacity on this industry has not yet become apparent."

2. A lack of effective effort by companies other than Phillips Chemical Co. to compete with Shell Chemical Co. in the West Coast market. Shell has the only production facilities west of the Rockies.

3. The possibility that the producers may place a ceiling on their synthetic rubber deliveries to small business firms, while increasing total capacity and production.

"This," Brownell pointed out, "would mean a diminishing of the relative share

of small business, hardly in accord with the objectives of the Disposal Act."

He emphasized, however, that he raised this question only as "a matter of speculative concern," not because he had any real reason to complain of it as yet.

Second of Ten Reports

The Justice Department chief filed his report—covering the calendar year 1956—under a mandate from the Senate Banking Committee to appraise on an annual basis the competitive picture in an industry spawned by the government itself. This is the second of ten reports under the mandate and the first to cover a full 12-month period. The first, issued in May of last year,¹ covered the last eight months of 1955, following disposal of most of the government's 27 synthetic rubber facilities.

Brownell, defining the scope of his responsibility as he sees it, said the Department's investigation covered all known producers of SBR and butyl rubber (IIR), plus the feed material butadiene. It included companies which acquired facilities under the government's disposal program as well as firms which constructed their own facilities. The survey also covered a representative sample of small business enterprises engaged in fabricating rubber products (as defined in the Disposal Act).

By way of background, the government has sold everything it ever owned except the alcohol-butadiene plant at Louisville, which is under lease to Publicker Industries of Philadelphia until next April, and related catalyst-producing equipment in mothball status at Baltimore.

SBR Capacity Double by 1958?

During 1956 the new industry produced

¹RUBBER WORLD, June, 1956, pp. 399, 427.

0

ff
n
er

y
ar
d

d with

raised
pecula-
my real

led his
1956—
anking
l basis
industry
This is
e man-
-month
of last
ths of
of the
ilities.
his re-
Depart-
known
(HIR),
It in-
ilities
rogram
d their
ered a
usiness
rubber
Act).
nment
except
isville,
Indus-
il, and
ent in

roduced

9, 427.

ORLD

always uniform

bag after bag...carload after carload

STATEX-B

FF

good reenforcement and tear at low cost

COLUMBIAN CARBON COMPANY



STATEX[®]-125 ISAF

(Intermediate Super Abrasion Furnace)

STATEX-R HAF

(High Abrasion Furnace)

STANDARD MICRONEX[®] MPC

(Medium Processing Channel)

MICRONEX W-6 EPC

(Easy Processing Channel)

STATEX-B F F

(Fine Furnace)

STATEX-M FEF

(Fast Extruding Furnace)

STATEX-93 HMF

(High Modulus Furnace)

FURNEX[®] SRF

(Semi-Reinforcing Furnace)

COLUMBIAN CARBON COMPANY

380 Madison Avenue, New York 17, N. Y.



Amer
Copo
The
Good
Phillip
Shell
Texas
United
United
All O

*Don
Sour
furnish

Ameri
Cor
Copol
cal
The F
Co.
Gener
Co.
Goodn
Goody
Cor
Phillip
Shell
Texas
United
United
Co.

*Prod
of prod
Source

1,079.
this r
9%;
ber (N
gram
basic
butyl,
segme
Exp
during
ation.
1955
098,00
almost
expans
tons b
"To
for ra
"corre
was a
severa
the fie
cal Co
leum
structi
view,
early
ber C
butadi

*New
prene.
ASTM
Testing

Augu

TABLE 1. MARKET POSITION OF SBR PRODUCERS, 1955-56

Company	% of Capacity		% of Production		% of Sales*	
	May 1, 1955	Dec. 31, 1956	1955	1956	1955	1956
American Synthetic Rubber Corp.	6.0	4.0	6.6	4.4	5.3	4.5
Copolymer Rubber & Chemical Corp.	6.7	5.5	6.4	6.8	5.6	6.8
The Firestone Tire & Rubber Co.	17.7	17.3	19.1	20.6	19.9	18.1
Goodrich-Gulf Chemicals, Inc.	12.3	21.1	12.7	12.9	10.3	11.5
Goodyear Synthetic Rubber Corp.	15.6	14.6	17.7	18.4	23.0	16.6
Phillips Chemical Co.	8.6	6.5	7.1	6.9	8.0	9.7
Shell Chemical Corp.	12.1	11.5	10.2	9.6	10.6	10.0
Texas-U. S. Chemical Co.	12.0	11.6	12.0	12.8	10.4	12.5
United States Rubber Co.	3.0	2.3	2.6	2.7	1.9	2.7
United Rubber & Chemical Co.	6.0	5.6	3.7	4.9	5.0	7.6
All Other			1.9			
Total	100.0	100.0	100.0	100.0	100.0	100.0

*Domestic sales, including intracompany transfers.

Sources: 1955 data from the First Report of the Attorney General, p. 7; 1956 data based on information furnished to the Department by the producers.

TABLE 2. SBR PLANT CAPACITY,* 1955-57, BY COMPANY
[Thousands Long Tons]

Company	May 1, 1955		Dec. 31, 1955		Dec. 31, 1956		Dec. 31, 1957	
	Long Tons	% of Total	Long Tons	% of Total	Long Tons	% of Total	Long Tons	% of Total
American Synthetic Rubber Corp.	44.0	6.0	50.0	5.6	43.5	4.0	68.5	5.0
Copolymer Rubber & Chemical Corp.	49.0	6.6	57.0	6.4	60.0	5.5	75.0	5.4
The Firestone Tire & Rubber Co.	129.6	17.6	150.0	16.8	190.0	17.3	230.0	16.7
General Rubber Synthetics Co.							40.0	2.9
Goodrich-Gulf Chemicals, Inc.	95.0	12.9	110.0	12.4	232.0	21.1	242.0	17.6
Goodyear Synthetic Rubber Corp.	146.5	19.9	160.5	18.1	160.5	14.6	241.0	17.5
Phillips Chemical Co.	69.4	9.4	69.4	7.8	72.0	6.5	130.0	9.4
Shell Chemical Co.	94.0	12.7	102.0	11.5	126.0	11.5	126.0	9.2
Texas-U. S. Chemical Co.	88.0	11.9	106.0	11.9	127.0	11.6	127.0	9.2
United States Rubber Co.								
United Rubber & Chemical Co.	22.2	3.0	22.2	2.5	25.0	2.3	30.0	2.2
			62.0	7.0	62.0	5.6	68.0	4.9
Total	737.2	100.0	889.1	100.0	1,098.0	100.0	1,377.5	100.0

*Productive capacity, including the weight of oil and carbon black, and assuming the "normal pattern of production" experienced by the company.

Source: Estimates furnished to the Department by the producers.

1,079,574 long tons of synthetic rubber in this ratio: SBR,² 81%; neoprene (CR),² 9%; butyl (IIR),² 7%; and nitrile rubber (NBR),² 3%. Since the disposal program transferred to private ownership only basic production facilities for SBR and butyl, the Brownell report deals with this segment of the industry only.

Expansion of SBR production capacity during the first 20 months of private operation, Brownell reported, raised the May, 1955 figure by 737,200 long tons to 1,098,000 long tons at the end of 1956, or almost 50%. Furthermore, he said, planned expansion will boost this to 1,377,500 long tons by the end of this year.

"To meet the expanding requirements for raw materials," the report continued, "corresponding butadiene plant expansion was also put in motion in 1956, and several new producers prepared to enter the field. The Texas Butadiene and Chemical Corp., jointly owned by Warren Petroleum Co. and The Fluor Corp., began construction of a butadiene plant at Channelview, Tex., scheduled to go on stream early in 1957. The Firestone Tire & Rubber Co. undertook the building of a new butadiene plant at Orange, Tex., to be in

²New ASTM abbreviations for GR-S, neoprene, butyl, and nitrile rubbers, respectively, ASTM D 1418-56T, American Society for Testing Materials, Philadelphia, Pa.

production in 1957. A third new butadiene producer, Odena Butadiene Co., began construction of a plant at Odessa, Tex., planned for operation early in the Fall of 1957."

SBR Competition Pattern

Brownell found relatively little change in the production and market positions of the ten major producers of SBR from his 1955 study of the industry. By the acquisition of the government plant at Institute, W. Va., early last year, Goodrich-Gulf increased its share of production capacity from 12.3 to 21.1%, the largest potential producer in the industry. Firestone, however, continued as high producer and seller, though second in capacity, with 20.6% of production and 18.1% of sales.

Goodyear ranked second in production and sales, with 18.4 and 16.6%, respectively, though it dropped to third place in capacity, with 14.6%. In the aggregate, the top five producers (Firestone, Goodyear, Goodrich-Gulf, Texas-U. S. Chemical, and Shell Chemical) strengthened their relative position in the industry. They captured an additional 9.4% of total capacity and 2.6% of total production, while paradoxically, losing 5.5% of domestic sales. (See Table 1.) This decline, how-

TABLE 3. PRODUCTION OF SBR BY TYPES, 1955-1956

Type	1955		1956	
	Long Tons*	% of Total	Long Tons*	% of Total
Regular SBR	139,735	27.4	190,375	23.7
Cold SBR	211,092	41.4	357,964	44.6
Oil masterbatch	115,172	22.6	191,476	23.9
Black masterbatch	16,201	2.2	15,136	1.9
And regular black masterbatch	27,760	5.4	47,632	5.9
Total	509,870	100.0	802,583	100.0

*Does not include oil content.

Source: Department of Commerce, United States Rubber Statistics (Feb., 1956, and Feb., 1957).

ever, was offset by a sharp increase in sales to overseas buyers.

SBR Expansion Details

Since the expansion planned and under way is shared by all producers, Brownell said the overall pattern of production in the industry "seems likely to hold for the near future." Table 2 compares SBR capacity for 1955, 1956, and 1957 (projected):

The Attorney General pointed out that individual expansion programs range from 6% by United Rubber & Chemical to 155% by Goodrich-Gulf. Despite this seeming disparity, however, Table 2 shows that the share of capacity (17.4%) held by the four smallest producers will remain unchanged at the end of 1957. Moreover, their ranks will be strengthened, he noted, by the entry of General Rubber Synthetics Co., with approximately 3% of domestic capacity. On the other hand, he added, the aggregate share of capacity held by Firestone, Goodrich-Gulf, and Goodyear is likely to hold at the 1956 percentage (53) after a rise from 50.4% from 1955.

His study of SBR by types indicates a continuing shift from regular SBR to cold rubber, as shown by Table 3.

Carrying this phase of his study a step further, Brownell put together a particularly interesting table on the percentage distribution of each type. As anticipated by the nature of the government's operation, he said, some highly specialized plants have been insulated from competition. For the two principal types—cold SBR and cold oil masterbatch—however, he found a wide distribution of supply. (See Table 4.)

In a special section on SBR latex, Brownell showed a corresponding drop in the consumption of natural latex and rise in consumption of synthetic latex. During the period 1950-56, he pointed out, natural latex fell from a 59% share of the U. S. market to a 48% share. Estimated consumption of SBR latex last year, he said, was 65,000 tons. The growing demand for SBR latex has not been accompanied by a growth in the number of producers.

Of the six firms manufacturing this product, the report said, Firestone, Goodyear, and U. S. Rubber account for more than 75% of total output. Their aggregate share, however, dropped from 83.8% in 1955 to 78.8% in 1956. Copolymer Chemical and Goodrich-Gulf, expanded their shares slightly over the same period. (Table 5.)

TABLE 4. PERCENTAGE DISTRIBUTION OF SBR PRODUCTION BY COMPANY BY TYPES, 1955-56

Company	Carbon Black Masterbatch Cold and Regular		Oil Black Masterbatch, Cold		Oil Masterbatch, Cold		Cold*		Regular*	
	1955	1956	1955	1956	1955	1956	1955	1956	1955	1956
American Synthetic Rubber Corp.	5.4	5.9	3.2	1.9	22.6	23.9	41.4	44.6	27.4	23.7
Copolymer Rubber & Chemical Corp.						0.7	15.9	9.8		.8
The Firestone Tire & Rubber Co.					2.7	5.3	14.0	12.8		
Goodrich-Gulf Chemicals, Inc.					19.7	19.4	16.4	19.4	28.7	31.9
Goodyear Synthetic Rubber Corp.					9.1	8.6	18.5	18.6	10.6	12.3
Phillips Chemical Co.	39.0	28.8	13.6	21.9	29.3	29.0	10.8	14.4	24.3	18.1
Shell Chemical Co.	9.9	12.6	9.1	0.5	7.4	6.6	4.4	4.0	3.4	6.0
Texas-U. S. Chemical Co.					14.2	12.6	8.0	8.3	10.5	8.0
United States Rubber Co.					17.6	17.8	9.3	10.3	15.4	15.1
United Rubber & Chemical Co.							2.7	2.4	5.3	7.8
All other ²	34.3	58.6	61.4	77.6						
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

*Not masterbatched; includes latex.

¹Represents Baytown's production prior to acquisition by United Rubber & Chemical Co.

Source: 1955: First Report of the Attorney General, p. 8, 1956: Information furnished to the Department by the producers.

TABLE 6. DISTRIBUTION OF BUTADIENE CAPACITY, PRODUCTION, AND SALES BY COMPANY, 1955-56

Company	% of Total Capacity		% of Production		% of Sales		Sales in Open Market, % of Total	
	May 1, 1955	Dec. 31, 1956	1955	1956	1955	1956	1955	1956
Copolymer Rubber & Chemical Corp.	3.8	4.0	4.8	4.3	4.8	5.0	0.1	0.0
Dow Chemical Corp.	1.3	1.7	1.1	1.7	1.1	1.5	100.0	3.8
Esso Standard Oil Co.	5.5	5.3	4.7	4.8	4.6	4.3	100.0	100.0
Goodrich-Gulf Chemical Inc.*	15.9	14.7	16.2	15.3	15.9	14.7	26.2	21.7
Humble Oil & Refining Co.	7.7	6.5	7.2	6.9	9.7	6.4	100.0	100.0
Petro-Tex Chemicals Corp.	15.0	15.4	15.0	15.1	14.7	15.2	100.0	100.0
Petroleum Chemicals Inc.	10.6	9.4	11.4	9.7	11.2	9.6	100.0	100.0
Phillips Chemical Co.	12.4	12.1	12.1	11.5	11.4	11.0	43.2	45.7
Publicker Industries, Inc.			\$1.2	2.2	\$1.1	2.1	\$100.0	100.0
Shell Chemical Co.†								
Standard Oil Co. of Calif.‡	10.6	9.4	7.7	6.8	7.5	6.8	0.0	0.0
Texas-U. S. Chemical Corp.		2.1	2.3	2.2	2.3	4.3	100.0	100.0
United Carbide & Carbon Corp.	15.9	14.7	15.2	14.9	14.6	14.6	30.0	29.6
Total	100.0	100.0	100.0	100.0	100.0	100.0	60.8	53.4

*Each of these companies bought an undivided half interest in the Nacogdoches, Tex., butadiene plant.

†Includes intracompany transfers.

‡The plants purchased by Shell Chemical Co. and Standard Oil Co. of California operated in tandem, and the percentage shown represents the joint capacity of both plants.

§Publicker leased the Louisville, Ky., alcohol butadiene plant from the government on March 25, 1955. Source: Information furnished to the Department by the producers.

West Coast and Export Markets

The Attorney General put special emphasis on two synthetic rubber markets—the West Coast and abroad. On the first, he reminded the Congress that Shell owns all SBR capacity in the West, but said this situation has been generally counter-balanced by the buying power of the major tire companies. On the second, he reported a 44% increase in export sales for a 1956 total of 149,168 long tons, including an 84% increase in exports of SBR.

"This expansion," he explained, "was supported by an increase in production and a decline in domestic consumption, making a substantially larger volume available for shipment abroad. At the same time, domestic producers increased their foreign sales facilities."

"While all domestic producers exported

some GR-S in 1956. Firestone, Goodyear, and Goodrich accounted for approximately 82% of the total. In 1955 almost half the rubber sold abroad went to foreign subsidiaries or affiliates of the domestic GR-S producers. In 1956, however, this ratio of sales to foreign affiliates declined to 43%, indicating a slight broadening of the foreign market.

"Under private ownership, the price at which GR-S was sold to foreign customers was initially from one to two cents above the domestic price. In July, 1956, most producers reduced the export price to the level of the domestic price, with an allowance for transportation to specified ports."

Prices and Sales Contracts

On the question of domestic prices, Brownell said the industry went a full year

TABLE 5. PERCENTAGE DISTRIBUTION OF SBR LATEX PRODUCTION, 1955-56

Company	1955 % of Total	1956 % of Total
American Synthetic Rubber Corp.		
Copolymer Chemical & Rubber Corp.	10.0	11.9
The Firestone Tire & Rubber Corp.	34.1	32.4
Goodrich-Gulf Chemicals, Inc.	2.4	6.3
Goodyear Synthetic Rubber Corp.	26.3	24.0
Phillips Chemical Co.		
Shell Chemical Co.	3.8	3.0
Texas-U. S. Chemical Co.	(*)	(*)
United States Rubber Co.	23.4	22.4
United Rubber & Chemical Co.		
Total	100.0	100.0

*Less than 0.1% of 1%.

Source: 1955: First Report of the Attorney General, p. 9, 1956: Information furnished to the Department by the producers.

after May, 1955, with a uniform price level, except for six firms quoting delivered prices instead of f.o.b. An unsuccessful attempt by Goodrich-Gulf to increase its delivered base price in May-June of last year was followed by down-the-line adjustments of others, bringing a uniform f.o.b. price of 23c per pound and a delivered price of 24.1c.

"Thus, while 1956 brought the first re-adjustment of the price structure," it was pointed out, "the result was a uniform price." Brownell called the mid-year adjustment a recognition of market softening.

Discussing a price corollary—sales contracts—the Attorney General said his study of sales contracts indicated there was little price advantage to customers under the several types of contracts common to the industry—one exception was a quantity discount policy of one producer. The contracts assure buyers of minimum quantities of rubber under any future market situation; whereas spot purchasers feel price changes immediately.

Butadiene Market and Prices

Brownell's report on SBR raw materials was devoted almost entirely to butadiene, passing over styrene with a prediction that lower prices would take effect about mid-1957.

"The problems of butadiene are more complex," was the terse comment.

"It was clear at the outset that any feasible program of butadiene plant disposal could achieve competitive operation only for a limited number of plants. Most butadiene facilities had been deliberately located to supply the needs of specific copolymer plants. However, heavy demands for GR-S up until mid-1956 had tightened the supply of butadiene and introduced new seller-buyer relationships. Nevertheless, these arrangements, born of necessity, are not expected to become a permanent part of the competitive structure."

After noting that the buyer's market kept open the uneconomical alcohol butadiene plant at Louisville through last August, Brownell went on to report that petroleum butadiene production experienced "little change" from 1955. The leading trio, Petro-Tex, Goodrich-Gulf, and Texas-U. S., accounted for 45 to 47% of the market, depending upon which of three yardsticks was used—each of the three accounted for

about 15%. Two others, Petroleum Chemicals and Phillips, ranked fourth and fifth in both 1955 and 1956, each with about 11% of the market. He also noted, as indicated by Table 6, that the market held by these five dropped 4% in 1956.

Recalling that the Government's Disposal Commission had required certain "open market" set-asides because of the relatively high degree of integrated ownership of SBR and butadiene capacity, Brownell said some 53.4% of all butadiene sold in the U. S. market last year "could be classified as open market sales"—transactions between independently owned sellers and buyers.

Although this decline was almost 8% below the 1955 figure, the agency chief commented, a substantial amount of the butadiene went to adjacent unaffiliated copolymer plants. With such sales excluded, the 1956 figure was only 27%, as against 40% in 1955.

"Continuance of this decline in such sales," he warned, "could seriously impair the influence of the open market in determining butadiene prices."

Butadiene prices, Brownell added, held fairly stable during the year at 14-14.5¢ a pound for contract purchases and 15-15.5¢ for spot transactions. Feedstocks "appear to have been adequate to meet the producers' requirements," he declared.

Butadiene Expansions

Over the 20 month-period of both reports, butadiene capacity was increased by one-fifth to 748,500 short tons on December 31, 1956; in the same period, SBR capacity rose by 50%. Expansion currently planned or under way, Brownell estimated, will lift butadiene capacity to 1,065,400 short tons by end-1957.

"This," he observed, "should provide adequate butadiene for the GR-S capacity expansion then scheduled to be in operation." (See Table 7.)

The four largest producers continued their aggregate at about 57% of total U. S. production, Brownell stated, but "considerable competitive significance" should be attached to the entry of three new producers this year. They are Firestone, Odessa Butadiene, and Texas Butadiene—jointly accounting for 16% of the industry's expanded capacity. Brownell, with tongue in cheek, pointed out:

"This increase in the number of producers may well lessen the market influence exercised by the larger producers."

SBR and IIR to Small Business

In a section entitled, "How Small Business Fared," the Attorney General reported that he got a "unanimous" expression of "general satisfaction" from the 70 firms canvassed. The 1956 change most advantageous to small business, he declared, was the expansion of SBR capacity, making supplies easier to obtain.

He revealed, however, that the percentage of sales to small business buyers, in terms of total production capacity, lagged behind the situation in 1955. Percentage-wise, Brownell said, purchases by small firms accounted for 24.9% of total sales of SBR in 1956, compared to 25.2% in 1955. (See Table 8.)

"In any event, adequate supplies of GR-S

TABLE 7. BUTADIENE PLANT CAPACITY, 1955-1957, BY COMPANY

Company	[Thousands short tons]							
	May 1, 1955		Dec. 31, 1955		Dec. 31, 1956		Dec. 31, 1957	
	Short Tons	% of Total	Short Tons	% of Total	Short Tons	% of Total	Short Tons	% of Total
Copolymer Rubber & Chemical Corp.	23.0	3.7	23.0	3.4	30.0	4.0	30.0	2.8
Dow Chemical Co.	n.a.	n.a.	12.5	1.8	12.5	1.7	17.4	1.6
Esso Standard Oil Co.	37.5	6.0	37.5	5.5	40.0	5.3	50.0	4.7
Firestone Tire & Rubber Co.							40.0	3.8
Goodrich Gulf Chemicals, Inc.	95.0	15.3	105.0	15.6	110.0	14.7	110.0	10.3
Humble Oil & Refining Co.	49.0	7.9	49.0	7.3	49.0	6.5	65.0	6.1
Odessa Butadiene Co.							50.0	4.7
Petroleum Chemicals, Inc.	63.5	10.2	65.0	9.6	70.0	9.4	80.0	7.5
Petro-Tex Chemical Corp.	90.0	14.5	100.0	14.8	115.0	15.4	200.0	18.8
Phillips Chemical Co.	74.0	11.9	74.0	11.0	91.0	12.1	112.0	10.5
Shell Chemical Corp.	50.0	8.1	60.0	8.9	70.0	9.4	70.0	6.6
Standard Oil Co. of Calif.	14.0	2.3	14.0	2.1	16.0	2.1	16.0	1.5
Texas Butadiene & Chemical Co.							80.0	7.5
Texas-U. S. Chemical Co.	95.0	15.3	105.0	15.6	110.0	14.7	110.0	10.3
Union Carbide & Carbon Corp.	30.0	4.8	30.0	4.4	35.0	4.7	35.0	3.3
Total*	621.0	100.0	675.0	100.0	748.5	100.0	1,065.4	100.0

*Excludes the 84,000 short tons of alcohol butadiene capacity of the government-owned Louisville, Ky., plant operated by Publicker Industries, Inc. until September, 1956, which is under lease by that company until March, 1958.

Source: Information furnished to the Department by the producers.

TABLE 8. PRODUCERS' SBR SALES TO SMALL BUSINESS ENTERPRISES, 1955-1956

Company	Ratio of Small Business Sales to—				Percentage of Production Committed by Contract
	Production		Total Sales		
	1955	1956	1955	1956	
American Synthetic Rubber Corp.	13.8	15.9	15.4	16.9	10.0
Copolymer Rubber & Chemical Corp.	11.4	9.1	11.8	9.4	10.0
The Firestone Tire & Rubber Co.	30.9	16.7	26.7	17.0	20.0
Goodrich-Gulf Chemicals, Inc.	19.8	19.4	21.8	19.9	27.5
Goodyear Synthetic Rubber Corp.	21.8	21.6	15.0	22.1	10.0
Phillips Chemical Co.	68.3	61.9	54.4	48.2	50.0
Shell Chemical Corp.	32.1	32.0	27.7	34.0	22.5
Texas-U. S. Chemical Co.	21.4	18.5	22.2	19.5	20.0
United States Rubber Co.	58.6	54.1	69.8	56.9	60.0
United Rubber & Chemical Co.	57.0	57.7	37.9	40.8	40.0
Industry Average	28.8	25.2	25.3	24.9	22.7

*Based on commitments made in testimony before House Armed Services Committee.

*Total sales include intracompany transfers.

†Paragraph 2 of the Appendix to the contract for the purchase of the Institute, W. Va., plant commits the company to set aside for small business enterprises 21,000 long tons of SBR when one line is in operation; 51,000 long tons when two lines are in operation; and 81,000 long tons when three lines are in operation. In 1956 the company operated one line with approximately 41,000 long tons of capacity. The 27.5% commitment is the ratio of the set aside pledged for the Port Neches plant plus that for one line at Institute to the capacity of Port Neches plus the capacity of one line at Institute.

were made available to small business during 1956," he discovered. "Nevertheless, if the small business supply is held rigidly to a physical volume based on capacity at the time of the purchase of the plants from the government, its relative share of output will grow progressively smaller as the industry's capacity expands."

On two other aspects of the small business picture, Brownell (1) complained that he is having trouble with his canvass because of the lack of a clearcut definition pinpointing which buyers are small businessmen, and (2) reported that the only marketer of butyl rubber—Enjay—sold 10% of its butyl to small business in 1955 and 13% in 1956.

Butyl Rubber

The total butyl picture, Brownell said, presented something of a puzzle in 1956 because consumption fell some 6,500 tons, while production rose 35% to almost twice consumption. The figures were 39,555 long tons and 74,988 long tons, respectively, for consumption and output.

Brownell also underscored "a unique pattern of cooperation" in the policy of Enjay's parent company, Standard Oil of New Jersey, to facilitate the entry of a new producer into the butyl field—Petroleum Chemicals, Inc. Early in 1956, Standard's Esso Research subsidiary agreed to make butyl available through Enjay for experimental sale by Petroleum Chemicals to determine the soundness of investment in a plant of its own. Subsequently, the company announced it will build a Louisiana plant for production of 30,000 long tons annually by the end of 1958 and ultimate annual capacity of 45,000 tons.

SBR Patents and Technology

As part of the disposal program, the government granted to all SBR plant purchasers the rights to all patents it held in the copolymer field. In 1956, the Attorney General said, he found "no serious problems" on patent rights, technical information, or know-how essential to SBR manufacture. On the basis of the 20-month period, he said it appeared to him that the

rights conveyed "were adequate to the needs of the purchasers."

The only new entrant in SBR manufacture, General Rubber Synthetics, has moved into the field without serious inconvenience in obtaining the information it needs, he explained, demonstrating "the government's willingness to aid any bona fide new entrant."

Brownell reported that all rubber research reports prepared for the government under its 1942-1949 synthetic rubber program are now in the hands of the Office of Technical Services, technical publications branch of the Commerce Department. Two types of reports were filed: "CR" reports covering original copolymer research, and "CD" reports on applied copolymer development research.

"All 'CR' reports submitted from February 1, 1943, through June 30, 1954, together with a substantial body of abstracts of technical papers from the government's synthetic rubber program," he revealed, "were transferred by the National Science Foundation in August, 1955, to the Office of Technical Services. Subsequently, additional 'CR' reports, covering fiscal year 1955 research, were also transferred to OTS and were made available to the public on November 16, 1956.

"All 'CD' reports filed between February 1, 1943, and June 30, 1956, were recently turned over to OTS and are expected to be released to the public in the near future.

The purpose of these transfers was to make the information readily available for use by business and industry upon application.

"Technical information contained in these reports represent substantially all such data obtained by the government under its research program in synthetic rubber. There are two avenues of access to this technical information. OTS provides access to the data, but has not yet granted rights to its use. Federal Facilities Corp., under the terms of the research agreements, can grant the government's rights to the resulting technology. The only company to utilize the latter avenue thus far has been General Rubber Synthetics Co."

Brownell said none of the purchasers of butadiene plants had taken advantage of the government's offer to request patents under the Oil Industry Process Agreement. Patents on all butadiene development through April 28, 1952, were available from the Agreement's four signatories—Shell Development Co., Phillips Petroleum, Universal Oil Products, and Esso Research & Engineering. Brownell said, however, the butadiene plant purchasers have preferred to negotiate licenses under the individually owned patents of each party, primarily to obtain rights to inventions since April, 1952. With some negotiations complete, and others still pending, he said the overall picture indicates "that satisfactory licenses will be consummated in the foreseeable future."

IRSG Estimates 1957 New Rubber Consumption Record; Synthetic Must Make Up Natural Supply Deficit

The thirteenth meeting of the International Rubber Study Group was held in Jogjakarta, Indonesia, June 24 to July 1. The meeting was attended by delegations from Australia, Austria, Belgium, British Colonial and Dependent Territories, Canada, Ceylon, Czechoslovakia, Denmark, France, Federal Republic of Germany, Hungary, Indonesia, Italy, Japan, Liberia, Netherlands, Thailand, United Kingdom, and the United States of America together with observers from the Food & Agricultural Organization and from the International Rubber Development Committee.

The chairman for this meeting of the IRSG was Dr. Sadjarwo, Minister of Agriculture of the Republic of Indonesia. The vice chairmen were Dr. Schafer, head of the delegation of the Federated Republic of Germany, and Mr. Lakshnakara Kashemsanta, head of the delegation of Thailand.

Production and Consumption Estimates

The Group examined the world's statistical position and made estimates for natural and synthetic rubber requirements and production. During 1957, it was estimated that the world might consume some 1,910,000 long tons of natural rubber and approximately 1,260,000 long tons of synthetic rubber apart from the synthetic rubber produced in non-member countries. It was estimated that the world production of natural rubber would be about 1,875,000 long tons; while production of synthetic rubber in member countries would be approximately 1,280,000 long tons. Tables 1, 2, and 3, of estimates made by the Group,

show that estimated production and requirements of both natural and synthetic rubber are approximately in balance.

Research and Development

The Group emphasized again the importance of continuing work on (1) the development of planting material combining a high level of disease resistance with high yield and (2) continuing international co-operation in the exchange of improved planting material between the research centers and rubber growing countries of the world, and noted with satisfaction that steady progress continued in the development and exchange of high-yielding and disease-resistant strains of *Hevea* rubber between research institutes and plantation countries in southeast Asia, in west Africa, and in the Western Hemisphere.

It also noted that following the recommendations of the eleventh and twelfth meetings of the IRSG, there had been a growing liaison between producers' and consumers' research organizations. The Group noted various new developments in connection with synthetic polymers and their application and also observed that work was proceeding in natural rubber producing organizations on graft polymers in natural rubber and the development of special types of natural rubber with distinctive properties.

The IRSG recorded its appreciation of the careful research and experimental work carried out by producers' research and technical organizations into Technically Classified Rubber, but noted that the large-scale

TABLE 1. ESTIMATED NATURAL AND SYNTHETIC RUBBER REQUIREMENTS IN 1957

	(In 1,000 long tons)		Total
	Natural	Synthetic	
United States	560	930	1490
United Kingdom	184	57	241
France	135	41	176
Federal Republic of Germany	129	47	176
Japan	122	15	137
Canada	45	51	96
Italy	55	17	72
Czechoslovakia	50	—	50
Australia	30	20	50
Belgium	22	7	29
Netherlands	20	4	24
Austria	10	3	13
Hungary	8	—	8
Denmark	7	1	8
Other Countries	533	67	600
Total	1,910	1,260	3,170

TABLE 2. ESTIMATED 1957 NATURAL RUBBER PRODUCTION

(In 1,000 long tons)	
Indonesia	670
Malaya	627
Thailand	134
Ceylon	91
Vietnam	67
British Africa	43
Sarawak	40
Liberia	37
Belgian Congo	34
Cambodia	31
Other British Borneo	21
Burma	13
Papua	4
French Africa	4
Other countries	59
Total	1,875

TABLE 3. ESTIMATED 1957 SYNTHETIC RUBBER PRODUCTION IN MEMBER COUNTRIES

(In 1,000 long tons)	
United States	1,135
Canada	130
Federal Republic of Germany	13
United Kingdom	2
Total	1,280

application of this material was not at present practicable and felt that consumers requiring TCR should make their own arrangements through market channels.

NR Quality and Standards

The Group also reviewed the progress since October, 1955, in the creation of international-type descriptions and packing specifications for natural rubber. It was noted with pleasure that the book entitled, "Type Descriptions and Packing Specifications for Natural Rubber Grades Used in International Trade," had been adopted by The Rubber Manufacturers Association, Inc., of the United States and endorsed by the Rubber Trade Association of New York and 23 other rubber producing and consuming organizations which about represented the world trade in natural rubber.

The IRSG noted with regret that according to statistics supplied by the United States delegation, a deterioration had taken place during 1956 in the conformance to grade in rubber shipments to the United States, especially in the Amber and Thin Brown crepes. Representatives of other consuming countries confirmed that there was a general trend toward lower conformance to grade. It was recognized that consumers

were now paying more attention to quality and that the apparent deterioration might well have been partially attributable to this fact. The IRSG reiterated its view that other production countries should adopt some supervision of grading and packing similar to that conducted in Malaya.

Market Stability

The IRSG noted with satisfaction that the statistical forecast for the coming year indicated continuing stability in market conditions, and it also noted that many of its member governments attached great importance to the development of measures to maintain and increase stability in the natural rubber market; while others were of the opinion that the expected continuance of high demand for new rubber would assure stability. In view of the apprehension of some countries over possible adverse developments in the future, the Group decided that it would consider at its next regular meeting the need of possible action to reduce fluctuations in the natural rubber market.

British Colonial and Dependent Territories, Canada, Ceylon, France, Federal Republic of Germany, Indonesia, Italy, Netherlands, the United Kingdom, and the United States of America will be members of the Management Committee until the next meeting of the IRSG. When in August, 1957, Malaya becomes a sovereign independent member of the British Commonwealth, it will take the place of the British Colonial and Dependent Territories delegation on the Management Committee, and this former delegation will then cease to exist as such. Territories other than Malaya now represented by it will continue to collaborate with the IRSG by other means.

The IRSG decided that it would hold its next meeting in May or June, 1958, at a place and date to be decided later.

RMA Comment

All of the above information was obtained from the RMA's cabled text of the communique of the IRSG meeting.

In its comments on the communique, the RMA points out the emphasis placed on the stabilizing potential of the United States synthetic rubber industry in terms of raw supply and cost by the IRSG.

That organization estimated total world production of synthetic rubber would exceed consumption by 20,000 long tons, and that consumption of natural rubber would exceed production by 35,000 long tons. In this country, the RMA said, the industry was quick to note two factors that would cushion the impact of such a deficit, should it develop. In the first place, 35,000 tons of natural rubber represent only about 4% of the total free stocks in the world, which now stand at more than 800,000 tons. In the second place, consumers outside the United States have shown a continued and growing interest in the use of synthetic rubber. U. S. exports totaled 151,877 tons in 1956 and are expected to amount to between 190,000 and 200,000 tons in 1957. The synthetic rubber industry in this country is geared to meet foreign demand as it rises, and rising orders would operate to balance out the supply-demand position of natural rubber.

Rubber Chemicals Output and Sales Down in 1956

According to preliminary statistics on United States production and sales of rubber processing chemicals in 1956, released in late June by the U. S. Tariff Commission, a decrease was recorded last year, compared to 1955, because of the lower amount of rubber that was consumed in 1956.

United States production of all rubber processing chemicals was 167 million pounds in 1956, 6% less than the 177 million pounds reported in 1955. Sales amounted to 132 million pounds, valued at \$81 million, in 1956, compared with 143 million pounds, valued at \$86 million, in 1955.

The output of cyclic rubber processing chemicals, thiazole accelerators, and amino

or hydroxy compound antioxidants primarily, amounted to 141 million pounds in 1956, compared to 148 million pounds in 1955. Sales were 111 million pounds, value \$67 million, in 1956, compared with 121 million pounds, valued at \$71 million, in the previous year.

The production of acyclic rubber processing chemicals, chiefly carbamates and thiuram accelerators and peptizers, amounted to 26 million pounds in 1956, compared with 29 million pounds in 1955. Sales amounted to 21 million pounds, valued at \$14 million in 1956, compared with 22 million pounds, valued at \$15 million in 1955.

The Tariff Commission's table of detailed statistics follows.

U. S. PRODUCTION AND SALES—RUBBER-PROCESSING CHEMICALS, 1956

Chemical	Production— 1,000 Pounds	Quantity— 1,000 Pounds	Sales Value— 1,000 Dollars	Unit Value*— Per Pound
Grand total	167,149	132,231	80,662	\$0.61
RUBBER-PROCESSING CHEMICALS, CYCLIC				
Total	141,440	111,126	67,208	.60
Accelerators, total	63,210	40,701	24,093	.59
Dithiocarbamic acid derivatives	211	208	384	1.85
Thiazole derivatives, total	53,121	31,851	17,118	.54
2,2'-Dithiobis (benzothiazole)	18,202	10,995	5,288	.48
2-Mercaptobenzothiazole†	15,727	3,221	1,204	.37
All other‡	19,192	17,635	10,626	.60
All other accelerators	9,878	8,642	6,591	.76
Antioxidants, total§	71,553	64,067	36,784	.57
Amino or hydroxy compounds	54,903	49,631	28,738	.58
Phenol, alkylated	1,630	1,071	508	.47
All other	15,020	13,365	7,538	.56
Peptizers, tackifiers, inhibitors, and blowing agents	6,677	6,358	6,331	1.00
RUBBER-PROCESSING CHEMICALS, ACYCLIC				
Total	25,709	21,105	13,454	.64
Accelerators, total	13,538	9,516	8,407	.88
Dithiocarbamic acid derivatives, total§	8,030	4,831	3,581	.74
Dibutylthiocarbamic acid, zinc salt	1,271	1,084	952	.88
Diethylthiocarbamic acid, zinc salt	1,787	1,526	890	.58
Dimethylthiocarbamic acid, potassium salt	208			
Sodium salt, and sodium polysulfide	3,035	1,089	410	.38
All other	1,729	1,132	1,329	1.17
Tetramethylthiuram sulfides, total**	4,805	4,297	4,429	1.03
Disulfide	3,515	3,292	3,313	1.01
Monosulfide	1,290	1,005	1,116	1.11
All other	703	388	397	1.02
Peptizers, stabilizers, lubricating, conditioning, and blowing agents, total	12,171	11,589	5,047	.44
Dodecyl mercaptans	7,109	7,101	3,219	.45
All other	5,062	4,488	1,828	.41

*Calculated on rounded figures.

†Includes small quantities produced and sold for uses other than rubber processing.

‡Sales of non-staining antioxidants are estimated at 12 million pounds, valued at \$8 million.

§Data on dithiocarbamates included in this table are for material used exclusively in the processing of natural and synthetic rubbers.

**Includes data for small amounts of tetramethylthiuram sulfides for uses other than in the processing of natural and synthetic rubbers.

Two Left in Commerce Rubber Unit; Statistics by Census

The Commerce Department's Rubber Branch, having barely escaped complete eradication, now stands as a two-employee unit after Congressional cuts in the Department's budget whittled the rubber staff sharply from its 10-man strength prior to July 1. Out of the Department after 40 years in government service is Everett G. Holt, former assistant director for rubber of the Chemical and Rubber Division, Business and Defense Services Administration. Holt retired even before his return from the International Rubber Study

Group meeting which ended July 1 after a week-long session at Jogjakarta, Indonesia.

His successor is S. E. Overley, chief of the Rubber Branch and the man left to pick up the pieces left by the Congressional economy ax. He holds out some hope that the Branch may be reenlarged to some degree, although its major statistical assignment—a monthly report on rubber production, consumption, and stocks—has been turned over to the Census Bureau. Commerce will continue to

have an important voice in how the statistics are handled, but the actual publication of them will be left to Census.

In the meantime the Rubber Branch will continue to handle industry inquiries, to the best of its severely limited ability, and to help interested government agencies on rubber problems arising in their fields. These include the Office of Defense Mobilization (in charge of the huge rubber stockpile), the General Services Administration (stockpile manager under ODM direction), the Tariff Commission (import-export matters), and the departments of State and Defense.

To all intents and purposes, however, the Branch has been seriously weakened, and its contribution to the preparedness program and industry alike reduced to a fragment.

Carbon Black Output Up, Sales Down, During 1956

Sales of carbon black by American producers declined 5% during 1956, while production exceeded the 1955 record figure by 6%, according to statistics issued by the United States Department of the Interior, Bureau of Mines. Last year's output of 1.8 billion pounds resulted in an increase of 111 million pounds in producers' stock.

Sales to rubber companies decreased 3% during 1956 as a result of a 6.9% decline in the production of rubber goods. Synthetic rubber production decreased 2%; while reclaimed rubber production was 14% below the figure of 1955.

One carbon black plant shut down in 1956, and one plant produced furnace black for the first time in 1956, to keep steady the total of 11 producers operating 42 plants in this country. Owing to the expansion of existing plants, operating capacity increased from 5,425,100 pounds daily in 1955 to 5,567,310 in 1956.

The volume of natural gas used as raw material in producing carbon black continued to decline, the Bureau of Mines reports. In 1956, 242,598 million cubic feet were used, compared to 244,794 million in 1955. More liquid hydrocarbons, 242 million gallons in 1956, compared to 221 million gallons in 1955, were used as raw material for furnace blacks.

The value of the 1956 carbon black production at the plants is put at \$120 million. The average value of total production was 6.53¢ per pound, 0.21¢ per pound lower than in 1955.

Federal Facilities Corp. Transferred to GSA

The General Services Administration in July took over the little that remains of the government's rubber disposal program, including jurisdiction over the alcohol-butadiene plant at Louisville, Ky.

"By coordinated action of the President and the Secretary of the Treasury," the Administration announced, "the Federal Facilities Corp. has been transferred from the jurisdiction of the Secretary of the Treasury to the jurisdiction of the Administrator of General Services."

"The FFC was organized in 1954 to conduct the operations of the govern-

ment-owned synthetic rubber producing facilities. The operation of the government tin program was also assigned to the Corporation. All these activities ceased some time ago.

"The principal function of the Corporation now consists of administering the contracts of sale or lease or rubber producing facilities entered into by the former Rubber Producing Facilities Disposal Commission. Hence supervision of the Corporation by the Administrator of General Services is appropriate."

That this was virtually an epitaph for FFC became apparent when it was learned that GSA Chief Franklin Floete would probably dissolve the Corporation "administratively," though continuing its legal corporate entity. The subject of a suit against the government, it cannot be "legally" dissolved until the suit is finally decided. Its remaining functions were expected, however, to be assigned to existing offices within GSA: (1) maintenance of Louisville, pending the expiration of a lease held by Publicker Industries of Philadelphia until April, 1958, to be taken over by the Public Building Service; (2) legal problems to be assigned to the GSA general counsel; and (3) collections under four rubber plant mortgages to be handled by the GSA controller.

The future of Louisville, once the Publicker lease expires, remains uncertain. Not uncertain, however, was the fact that it will definitely not be sold this year.

Akron Government Lab To Firestone for \$760,000

The future of the Akron Rubber Research Laboratories and Pilot Plant was all but sealed in July, once and for all, when the government prepared to accept the offer of Firestone Tire & Rubber Co. to purchase the facility for \$760,000. The Akron facilities, with a long history of contribution to synthetic rubber behind it, were put on the block late in April, but there was no certainty it would be sold to the highest bidder until last month.

Under a unique disposal program designed especially for this piece of federal real estate, the Akron facilities were first offered to other government agencies. The offer, however, had a string—it would go to the highest non-government bidder unless prudent economics indicated it should be assigned to the most interested agency.

The Department of Agriculture was the agency most anxious to have the facility, but the Bureau of the Budget decided the government's best interest lay in selling the plant to Firestone. The legislative history of the Akron disposal bill indicates, however, that some or all of the \$760,000 proceeds will be assigned to Secretary of Agriculture Ezra Taft Benson for the construction of laboratories specifically designed for the government's program to find new uses for food.

Sale to Firestone was recommended to the Bureau of the Budget by General Services Administrator Franklin Floete. He turned the file on the Akron facilities over to the Bureau shortly after the public bids were received in April. Included in it was the related report on GSA's canvass of

federal agencies. Budget Director Percival Brundage studied the proposition for several weeks, then authorized Floete to make the announcement that Akron would go to Firestone.

The research installation was built in 1943 on property adjacent to Firestone and operated by the University of Akron until "mothballed" last summer. The government wanted Akron U to operate the plant for a year rent-free, but the school's trustees rejected the offer on the ground that operating costs of almost \$1,000,000 were prohibitive.

Goodyear-URWA Agree On 14.5¢ Wage Increase

The Goodyear Tire & Rubber Co. and the United Rubber Workers of America, AFL-CIO, which had been negotiating on a wage increase since July 1 in Cleveland, O., agreed to a general wage increase for all Goodyear hourly employees, amounting to 14.5¢ an hour, on July 22. The deadline for such an agreement was July 22.

The increase will probably be termed a 15¢-an-hour increase, but the net for most employees will be 14.5¢. The reason for this situation was that when Goodyear signed a new general working conditions contract with the URWA in February of this year, it agreed to an increase of from 3¢ to 6¢ an hour for night work for the Akron, O., and certain other Goodyear plants, with the understanding that this night bonus increase would be deducted from any general wage increase granted this year. The cost across the board for the company amounted to about 1/2¢ an hour. Plants not covered in this February night bonus increase had received such an increase in 1953.

The three other Big Four companies, Firestone Tire & Rubber Co., The B. F. Goodrich Co., and United States Rubber Co., were at the time of this writing negotiating on wages with the URWA, and all had a July 29 deadline. It was expected that the Goodyear settlement would set a pattern for these companies, and that a similar increase would have been granted by July 29.

This year's wage increase is considerably more than the 6.2¢-an-hour increase granted in 1956 and more of the order of the 12¢-an-hour pay boost granted the URWA in 1955. Last year at this time the rubber industry was experiencing a decline in sales volume; while this year demand for rubber products is improving despite the fact that sales to the automotive industry are somewhat less than expected.

QM Contracts Awarded

United States Rubber Co., New York, N. Y., has been awarded three contracts by the Philadelphia Quartermaster Depot covering 14,760 pairs of men's rubber overshoes valued at \$59,925, 4,008 pairs of swim coral shoes worth \$35,029, and 6,200 linear yards of laminated nylon cloth valued at \$83,700.

Marathon Rubber Products Co., Wausau, Wis., has been awarded a \$43,848 contract for 7,987 men's synthetic rubber raincoats by the Philadelphia QM Depot.

Industry News

Dow Corning Opens New Fabrication Laboratory; Culmination of 11 Years of Silastic Research

The recent opening, during June, of a new Silastic experimental fabrication laboratory marks a high point in Dow Corning Corp.'s 11 years of research work in the silicone rubber field. The original fabrication laboratory, established in 1946, boasted a staff of two men, and the part-time use of one mill, an extruder, a molding press, and a curing oven.

Subsequent expansion of facilities, to keep pace with the growing demand for silicone rubbers as engineering materials culminated in the erection of the quarter-million-dollar laboratory that opened its doors this June to disseminate fabrication know-how to customers, salesmen, and personnel engaged in the production of Silastic goods.

The new fabrication laboratory, which occupies an area of 6,400 square feet in its own building, functions as an integral part of a larger research structure devoted to product engineering. The Silastic section of this group, headed by Philip C. Servais, also is equipped with development, pilot plant, and production control facilities.

The experimental fabrication section, under the direction of D. C. Youngs, has a staff of 11 men, uses modern equipment, and specializes in the development of new fabrication techniques, training of sales and engineering personnel both for the home company and for customer companies, and evaluating new Silastic stocks.

Two mills, centrally located so as to be convenient to the several fabrication sites, are available to soften stock and blend in the various ingredients. Nylon guides are used on the rollers to prevent contamination of organic materials. Cleanliness is stressed to the point of using filtered-air ventilation throughout the building.

To contrast the performance of silicone insulation as opposed to standard insulators, the larger mill, a 12- by 30-inch model, is powered by a 20-hp. silicone insulated, Class H electric motor. The motor will bear a 25-hp. load for an indefinite period owing to the heat-resistant characteristics of the silicone. The smaller mill, 12 by 24 inches, requires a capacity of 30-hp. when using a standard Class A motor.

Five hydraulic molding presses, ranging in size from 30 to 200 tons, a three-roll calender, and two extruders, are on hand to form the material. The extruders operate in conjunction with two hot-air vulcanizers, one of which is gas fired, while the other is electrically heated.

The latter vulcanizer was designed by fabrication laboratory technicians. Its heating chamber is lined with two woven

glass blankets containing resistance wire, each of which has a heating capacity of 7.2 kilowatts. The return section of the stainless-steel conveyor belt is heated by two 1,100-watt radiant heaters to maintain the temperature required to receive the extrusion.

Belt speeds can be varied from two to 30 feet per minute. The 16-foot gas fired model is twice as long as the electrically heated unit and moves the heated air faster and permits more rapid vulcanization. A 20-inch autoclave is available for steam vulcanization of items, such as rubber covered rolls, ducts, and tubes produced on a mandrel wrapping lathe.

Vulcanized material is taken to a post-curing area provided with five ovens. One of the ovens is a walk-in type; while the others include three standard laboratory types and one designed for temperatures up to 850° F.

For fabric coating, a vertical laboratory coating tower has a four-foot steamheated solvent removal zone, and a five-foot electrically heated vulcanizing zone. Coating data obtained with this unit can be equated to industrial scale applications.

One of the laboratory's fabrication developments facilitates the handling of long lengths of calendered, unreinforced, silicone rubber sheets. The sheets are received on plastic foil which permits them to be rolled into easily handled bundles whose surfaces are separated by

the foil interleaf. This permits vulcanization of greater quantities of sheet material and allows the fabricator to handle thin sheets without distortion.

Extrusion data have been gathered and organized to acquaint fabricators with temperatures and rates giving satisfactory results. One man devotes his time to the design of extruder dies, both for the laboratory and for customers.

The laboratory has also investigated the essential design requirements of post-curing ovens, especially ventilation methods. Volatile gases, which can reach hazardous concentrations as toxic or combustible vapors, should be vented to a point outside the building. Horizontal air circulation is recommended over vertical, and when gas burners are used as a heat source, the fresh air intake should supply the flame from the room rather than that recirculated from the ovens. This procedure is necessary as a result of an additional hazard of the low-polymer silicones which, if exposed to the flame, would deposit a fine silica powder on the parts being cured.

Medical and surgical applications have also been uncovered by the research group. These include heart valves, brain valves, and various tubes which will not react when exposed to human tissues and secretions.

Enka Nylon Expansion

A \$5,000,000 expansion of its nylon facilities at Enka, N. C., has been announced by American Enka Corp., New York, N. Y. The addition to the present nylon producing plant is expected to go into operation before the end of 1958.

The expansion will nearly triple Enka's production of fine denier nylon textile yarns and total capacity will be increased by 75%. The company began production of nylon staple fiber in March, 1954, and of filament textile yarns in 1956.



New Silastic fabrication laboratory: right foreground, electrically heated hot air vulcanizer; left center, gas fired vulcanizer; far background, left to right, 200-ton, 50-ton, and 30-ton presses; far left, lathe for mandrel wrapping work

ASTM Committee D-11 Assigns New SBR and SBR Latex Numbers

Committee D-11 on Rubber and Rubber-Like Materials of the American Society for Testing Materials through Subcommittee 13 on Synthetic Elastomers of D-11 has assigned new numbers to five styrene-butadiene rubbers (SBR) and three new SBR latices which have been brought on the market during the last several months. This procedure is in accordance with that established by Subcommittee 13 of D-11 and agreed to by the Committee, the Society, and the private producers of SBR and SBR latices. The chairman of Subcommittee 13, B. S. Garvey, Pennsalt Chemicals Corp., Wayne, Pa., and two representatives of the producers of SBR who are also members of Subcommittee 13, I. D. Patterson, Goodyear Tire & Rubber Co., Akron, O., and F. J. Sackfield, American Synthetic Rubber Corp., Louisville, Ky., comprise a working group for the assignment of these new numbers, subject to review and approval of the full membership of Subcommittee 13 and Committee D-11 and of the Society.

Numbers will be assigned in sequence by the chairman of Subcommittee 13, when a request has been submitted in appropriate form and when the description sub-

mitted is not adequately covered by a number already assigned. The descriptions will follow the practices recommended in ASTM D 1419-56T, Description of Types of Styrene-Butadiene Rubber (SBR) and ASTM D 1420-56T, Description of Types of Styrene-Butadiene Rubber (SBR) and Butadiene Rubber (BR) Latices.

These new numbers and description will be published in RUBBER WORLD periodically as received from the secretary of Committee D-11, J. J. Allen, Firestone Tire & Rubber Co., Akron, for the benefit of the industry. Once each year the new numbers and descriptions will be incorporated into D 1149-56T and D 1420-56T by appropriate action of Subcommittee 13 and Committee D-11 and of the Society.

When the government SBR plants were sold to private corporations in 1955, the code numbers for the various types of rubbers and latices and their specifications lost their validity and status. The private producers of SBR and SBR latices found, however, both the code numbers and the uniformity of product resulting from the specifications to be highly desirable features in the use of SBR and SBR latices. The producers have continued the use of

the numbers formerly used for GR-S and have stated that all rubbers and latices produced under any one of these numbers will continue to be the same as it was when produced as GR-S.

If the significance of the numbers is to be maintained, and the value of the system is to be preserved, some method of num-

TABLE 1. DESCRIPTION OF TYPES OF NEW STYRENE-BUTADIENE (SBR) RUBBERS—ASSIGNMENT OF NEW CODE NUMBERS—ASTM D 1419-56T

Number assigned	1605	1773	1778	1803	1812
Date assigned	5/1/57	5/1/57	5/1/57	5/1/57	5/1/57
Requested by	Phillips	Goodyear	Goodyear	Phillips	Phillips
Distinctive feature	FEF Blk MB	NST Naph Oil MB	NST Naph Oil MB	HAF Blk HI-AR Oil MB	ISAF Blk-HI-AR Oil MB
Close previous number, if any	—	1703	1707, 1708	—	—
Type	Cold Blk MB	Cold Oil MB	Cold Oil MB	Cold Oil- Blk MB	Cold Oil- Blk MB
Nominal Temp., °F.	43	43	43	43	43
Activator	FRA	FRA	FRA	FRA	FRA
Shortstop	ND	ND	ND	ND	ND
Antioxidant	NST	NST	NST	ST	ST
Catalyst	OHP	OHP	OHP	OHP	OHP
Emulsifier	FA	Mixed	Mixed	Mixed	Mixed
Nominal bound styrene, %	23.5	23.5	23.5	23.5	23.5
Nominal conversion, %	60	60	60	60	60
Nominal Mooney viscosity, ML, 1+4, 212° F., polymer	—	60	55	—	—
Nominal Mooney viscosity, ML, 1+4, 212° F., compound	62	—	—	65	57
Coagulation	GA	SA	SA	SA	SA
Carbon black, type	FEF	—	—	HAF	ISAF
%	33.3	—	—	28.6	26.7
Oil Type	—	NST- NAPH	NST- NAPH	HI-AR	HI-AR
Parts	—	25	37.5	25	37.5
Finishing	Normal	Normal	Normal	Normal	Normal

NOTE: Abbreviations and symbols are defined as follows:

AC-AL = Acid alum	NAPH = Naphthenic
AR = Aromatic	ND = Non-discoloring
BR-AL = Brine-alum	NST = Non-staining
D = Discoloring	OHP = Organic hydroperoxide
FA = Fatty acid	P = Persulfate
FRA = Free radical type, i.e., iron-pyrophosphate, peroxamine sulfoxylate	RA = Rosin acid
GA = Glue acid	SA = Salt-acid
HI-AR = Highly aromatic	SL ST = Slightly staining
MB = Masterbatch	ST = Staining
	SP = Special finishing

TABLE 2. DESCRIPTION OF TYPES OF NEW STYRENE-BUTADIENE RUBBER (SBR) AND BUTADIENE RUBBER (BR) LATICES—ASSIGNMENT OF NEW CODE NUMBERS—ASTM D 1420-56T

Number assigned	2110	2111	2112
Date assigned	5/29/57	5/29/57	5/29/57
Requested by	Copolymer Rubber & Chemical Corp.		
Distinctive feature	FA Emulsi- fier— 60 % Solids	RA Emulsi- fier— 20 % Solids	RA Emulsi- fier— 40 % Solids
Close Previous Number, if any	—	—	—
Type	High Solids- Cold SBR Latex	Low Solids- Cold SBR Latex	Low Solids- Cold SBR Latex
Nominal temp., °F.	50	50	50
Activator	FRA	FRA	FRA
Shortstop	ND	ND	ND
Catalyst	OHP	OHP	OHP
Emulsifier	FA	RA	RA
Nominal conversion, %	60	60	60
Nominal Mooney viscosity, ML 1+4 (212° F.), polymer	—	52	52
Nominal residual volatile unsaturation, %	0.10	0.10	0.10
Nominal pH	9.5	9.5	9.5
Nominal surface tension, dynes/cm.	—	—	—
Nominal coagulum, No. 80 screen, %	0.10	0.10	0.10
Nominal bound styrene, %	25	23.5	23.5
Nominal total solids, %	60	20	40

NOTE: Abbreviations and symbols are defined as follows:

FA = Fatty acid
FRA = Free radical type
ND = Non-discoloring
OHP = Organic hydro peroxide
P = Persulfate
RA = Rosin acid

bering and at least describing these rubbers and latices had to be established. Such a method must be voluntary and cooperative and must be sponsored by an organization representing both producers and consumers of SBR and SBR latices. The ASTM seemed to be the logical organization for continuing the numbering and description of these rubbers and latices and has acted through Subcommittee 13 of Committee D-11, upon the request and with the approval of the producers and the consumers of SBR and SBR latices.

The first new numbers and type descriptions are given in Tables 1 and 2.

New Rubbermaid Products

Seven new Rubbermaid houseware products have been introduced for national distribution at the July Housewares Show, Atlantic City, N. J., by The Wooster Rubber Co., Wooster, O. The product group is the largest new items listing ever released at one time by the company.

The new items are: Rubbermaid Mixing Bowl Set, three colored, unbreakable, non-porous lightweight plastic bowls; Rubbermaid Round Bucket, a handled, household bucket with measuring markings; and Rubbermaid Facial Tissue Dispenser, a plastic tissue dispenser with sliding top for any size of tissue. Also a new laundry basket, a toilet top tray, a vanity wastebasket, and a dial-it dispenser, the latter being a combination container, shaker, pourer and strainer for liquid.

Use Sun Rubber Item

A core molded rubber drain connector manufactured by The Sun Rubber Co., Barberton, O., has helped make the new 1957 Hotpoint washer-drier more efficient, the rubber company says.

Hotpoint production engineers needed a rubber drain connector which would be capable of flexing in all directions while the washer-drier was in operation, without kinking or pulling loose from either end of its connection. Sun engineers designed a rubber connector with a bellows-type convoluted section capable of an extension and compression motion in all three dimensional planes.

The connector is made from a natural and synthetic rubber blend which is highly resistant to detergents, hot water, grease, and oil.

American Latex Lab

Construction of the Freedlander research and development laboratories, "A" division, as part of an overall construction and development program by American Latex Products Corp., Hawthorne, Calif., has been announced by President Clowes M. Christie. The two-story, 25,000-square foot, \$150,000 structure is scheduled for completion by September 15.

American Latex reveals it is currently allotting 13% of its sales dollar on chemical and engineering research, compared with 2-3% for industry as a whole.

Goodyear International Forms New Chemical Division



R. E. Workman

A new chemical division has been established within the Goodyear International Corp., subsidiary of The Goodyear Tire & Rubber Co., Akron, O. R. E. Workman has been appointed manager of the new division.

Sales policy and direction of the new division will be the responsibility of Herman R. Thies, general manager of the

chemical division, who will report to F. T. Magennis, president of Goodyear International Corp., on overall progress and results. The new division will handle all matters concerning overseas sales of synthetic rubber, rubber chemicals, plastic raw materials, and coating raw materials.

Mr. Workman has been awarded a Sloan Fellowship to Massachusetts Institute of Technology and will be absent from his post for one year. R. S. Earhart, assistant sales manager for the chemical division, has been named acting manager in his absence.

A home office and a field sales department have been created within the new division. J. S. Amrein was named administrative assistant and O. R. Gillen has been made manager of technical services for the home office department.

W. D. Porter has been appointed sales manager-Europe for the field sales department and will have as field representatives G. H. Campbell, J. H. Drexler, F. W. Milward, and C. S. Pyne. N. P. Wileman and P. A. Colgate have been named field representatives for the Far Eastern and Western Hemisphere areas.

Mr. Workman joined Goodyear in 1942 and has served as research division chemist, sales representative with the chemical division, and district manager of the St. Louis sales area. He had been assistant to the general manager of the chemical division since 1954.

Closer Ties to European Markets Seen by Firestone

Raymond C. Firestone, president, Firestone Tire & Rubber Co., Akron, O., on his return from a European business trip in mid-July said that the American business economy would become progressively more closely tied to European markets. He added that the European economy may advance even faster than the United States economy in the next few years.

"During the last 15 years Europeans have become more and more familiar with the products of American industry, and they like those products and have confidence in them," Mr. Firestone said. "Now the European economy is beginning to flourish, and Europeans want American products and have the money to buy them."

He pointed out, however, that while European markets of American products were growing stronger, American manufacturers would face increasingly strong competition from European manufacturers. He said that "know-how," which has been considered a strictly American product, is not exclusively ours as was evident in abundance in the many countries he visited. This fact was considered to be an advantage rather than a disadvantage for American industry.

"The competitive spirit derived from this very 'know-how' has made America prosper," he said. "There is no reason to doubt that the world will prosper under the same conditions."

In assessing the progress in Europe, Mr. Firestone emphasized that vehicle registrations in nations outside the Iron Curtain countries increased more than 200% from

January, 1948, to January, 1957. At the same time vehicle registrations in the United States increased 72%.

He said that consumption of rubber in these same countries increased almost 70%; while in the United States the increase was a little over 34% for the same period.

Mr. Firestone predicted that business in the United States and in Europe would stay at a high level and perhaps increase during the remaining months of 1957.

New Goodyear Plantation

The Goodyear Tire & Rubber Co., Akron, O., has organized a Guatemalan subsidiary corporation, Goodyear Rubber Plantations, Inc., which has acquired 3,400 acres of land in the southwest section of the country for the purpose of planting high-yield disease-resistant *Hevea* trees.

The company will encourage rubber growing in the Central American country by giving assistance to both large and small farmers in planting and cultivating the varieties of rubber best suited to the prevailing climatic and geographical conditions, Goodyear said.

During the six or seven years required for rubber tree maturity, the plantation will conduct experiments in interplanting coffee, corn, rice, and other food grains between the rubber trees.

The new plantation will be under the supervision of W. E. Klippert, manager of all Goodyear rubber plantations.

Du Pont's Cosler Retires

V. A. "Vic" Cosler, elastomers department, E. I. du Pont de Nemours & Co., Inc., retired on July 31 after a career of 40 years in the rubber industry. For the past 14 years he has been sales promotion manager for the company's synthetic rubbers and related products.

After graduating from Ohio State University in chemical engineering, he started his career in the rubber industry in 1917 with The B. F. Goodrich Co., where he remained for 13 years, becoming development manager and then technical superintendent of the mechanical goods division. In 1930 he moved to the Hewitt Rubber Co. as technical director, a position he held for four years.

Mr. Cosler joined the Du Pont company in 1934 in what was then the rubber chemicals division. He became sales development manager of that division in 1943.

During World War II he was a member of the Rubber Section of the War Production Board and at the same time acted as a special consultant to the research and development section of the Quartermaster Corps of the U. S. Army.

Mr. Cosler has been a member of the American Chemical Society and the American Society for Testing Materials for many years. He has also served on technical committees of The Rubber Manufacturers Association, Inc.

Mr. and Mrs. Cosler will travel for several months and then return to their home in Wilmington, Del.

Machine Firms Combine

Johnson Machinery Co., Newark, N. J., and Universal Hydraulics Machinery Co., New York, N. Y., have consolidated. Both companies specialize in used and rebuilt rubber, plastic, and hydraulic processing machinery.

The combined organization will operate out of the Johnson plant which has a floor area of 16,000 square feet, including sales, rebuilding facilities, and showroom. In addition, 62,000 square feet of storage space is maintained near Newark Airport to house the combined inventories.

The announcement of consolidation was made in a joint statement by Mrs. Irma Sacks, president of Universal, and Mayer A. Rubenstein, president of Johnson Machinery. Both companies were established in 1921.

Seiberling Tire Change

The Seiberling Rubber Co., Akron, O., has added nylon to its Super Service passenger tire, giving the firm's customers a choice of nylon cord construction in its entire line of passenger tires, with the exception of a mud-and-snow tire.

Other changes in the Super Service tire, according to the company, are the addition of "stop slots" to improve traction and the narrowing of the white sidewall and relocation of the sidewall bars for greater protection against scuffing.



Willard Stewart, Inc.

V. A. Cosler

Timken in Australia

The Timken Roller Bearing Co., Canton, O., is building a \$1,500,000 bearing plant in Ballarat, Australia, about 50 miles from Melbourne in the state of Victoria. The plant will contain 30,000 square feet of floor space and have a producing capacity of one million bearings a year.

Output of the plant will be supplemented by bearing shipments from the United States in order to afford a complete range of bearing sizes to Australia, New Zealand, and the Far East.

Elmer Schweitzer, the manager of the company's Zanesville operation, has been named managing director of Australian Timken Proprietary, Ltd., the corporate name of the company's Australian operation. The first building of the new plant is expected to be completed in a year.

Borden (Canada) Plant

Construction of a new \$400,000 plant in West Hill, a suburb of Toronto, Ont., has been begun by Borden Chemical Co. (Canada), Ltd. Scheduled for completion in the fall, the plant will produce adhesives and coatings for paper converting and other uses; textile and carpet backings and adhesives; and such maintenance materials as undercoating for cars, and asphalt emulsions and cutbacks for driveways.

Samples and formulae of the company's products were sealed in the cornerstone of the plant "to provide a benchmark for measuring future developments" in these products. The plant will be housed in a 17,000-square-foot building being erected on a 10-acre site.

The plant will consist of a main floor and mezzanine and, in addition to manufacturing facilities, will house a laboratory and offices, providing larger quarters than those now occupied at 20 Trent Ave., Toronto. An adjoining tank farm will store supplies of solvents, plasticizers, and asphalt.

Rubarite to Goodyear

The patents and the trade marks for Rubarite, the rubber-mineral powder widely used in highway construction and for industrial purposes has been acquired by The Goodyear Tire & Rubber Co., Akron, O. Rubarite, Inc., in which Goodyear held a one-third interest, has been reorganized and is now owned entirely by National Lead Co., New York, N. Y.

A Rubarite manufacture and sales department has been established by Goodyear for production and merchandising purposes. A new line of products will be offered for use in additives in improving the qualities of asphalt and tar for road building and miscellaneous industrial applications such as roofing materials, pipe coatings, joint sealers, and adhesives.

These improved bitumen rubberizing materials, containing 40% by weight of unvulcanized synthetic rubber, are said to have superior dispersion and suspension qualities in asphalt and tar. The new products will be manufactured under the administration of Goodyear's research division and under the direction of H. A. Endres, manager of rubber and plastics research.

Water F. Winters, formerly chief engineer of Rubarite, Inc., has been retained by Goodyear as consulting engineer. He will be concerned chiefly with the promotion of Rubarite products in bituminous road construction.

Sales and technical service for industrial applications of Rubarite will be handled by the Goodyear chemical division's field sales organization. Laboratory and field sales will be coordinated in Akron by the chemical division's rubber and rubber chemicals department.

Heyden Newport Plant

Heyden Newport Chemical Corp., New York, N. Y., is constructing a new plant at Pensacola, Fla., to produce terpene alcohol esters used in the rubber, plastic and other industries. The plant, scheduled for completion before the end of the year, is part of the company's expansion program for up-grading turpentine-based products, according to Simon Askin, president.

The company plans large-volume production of terpinyl acetate and iso-bornyl acetate, used as industrial odorants.

Marketing Fibra-Flo

Johns-Manville Corp., New York, N. Y., has begun marketing Fibra-Flo, a combination of asbestos and diatomite, in a line of filter aids for which filtration flexibility, greater efficiency, and lower cost of operation are claimed.

Fibra-Flo was developed in the company's Manville, N. J., research center and first marketed in the brewing industry. Johns-Manville is one of the nation's largest producers of both asbestos and diatomite. More than 100 different combinations of the two materials have been developed for industrial use.

Keener Succeeds Richardson as B. F. Goodrich President

William S. Richardson, president of The B. F. Goodrich Co., Akron, O., retired on July 31 after a 31-year association with the company. J. W. Keener, executive vice president, has been elected president, director, and a member of the company's executive committee. Mr. Richardson will continue as a director of the company.

Reuben B. Robertson, Jr., president of Champion Paper & Fibre Co., who in April resigned as Deputy Secretary of Defense, has been elected a member of the board of directors of Goodrich. He was first elected to the company's board of directors in 1953 but resigned two years later prior to his appointment as Deputy Secretary of Defense.

Mr. Keener, 48, joined Goodrich in 1937 as a research analyst. He served successively in marketing research, as director of business research, assistant to the financial vice president, and assistant to the president. In 1946 he was elected vice president-employee relations and four years later became vice president with corporate staff responsibilities. Last year he was elected executive vice president with operating responsibility for several of the company's divisions.

Mr. Richardson joined the company in 1926. He became manager of factory planning and was later named general sales manager of the industrial products division. In 1943 he was named general manager of the newly-established chemical



J. W. Keener

division, and in 1945 president of B. F. Goodrich Chemical Co. He was elected executive vice president, director, and member of the executive committee in 1952, and president of the company two years later.

He was the first president of Goodrich-Gulf Chemicals and has been a director of B. F. Goodrich Canada, Ltd., and of British Geon, Ltd.

Jefferson Alkali Sales

A new alkali sales division to market caustic soda and other alkalis has been formed by Jefferson Chemical Co., Inc., Houston, Tex. The move has been made as a forerunner to production of caustic soda in the company's new chlorine plant at Port Neches, Tex., scheduled for completion late in 1958.

The new division will be headquartered in the company's New York, N. Y., offices. William F. Phillips, formerly of American Cyanamid Co., has been named manager. Joining him will be Joseph F. Hickey, J. Beekman Fish, and George E. Taylor, all formerly associated with American Cyanamid.

Jefferson has assumed responsibility for sales and service of alkalis formerly marketed by American Cyanamid. The Houston company is jointly owned by American Cyanamid and Texas Co.

New Du Pont Sales Lab

A new sales development laboratory has been established at Carney's Point, N. J., by the explosives department of E. I. du Pont de Nemours & Co., Wilmington, Del.

The laboratory will seek to provide customers with technical service in the use of the department's existing products, find new uses for existing products, and develop markets for new products discovered by company research. Such industries as rubber, oil, chemical, lacquer, detergent, paper, and alloy steel will be served.

Timken Bearing Ratings Up

The capacity rating of most series of bearings made by The Timken Roller Bearing Co., Canton, O., has been increased by about 10%, with some increased by as much as 39%, the company reveals.

The increased rating is said to make possible the use of smaller bearings in many applications, resulting in a more compact product, using less material, since the size of shafts and housings can be commensurately reduced. New applications for the bearings are also anticipated.

A review of more than 6000 different laboratory studies of bearing performance on fatigue life machines, a review of the life of millions of Timken bearings in the field, and refinements in the method of analyzing these studies mathematically, were the three factors listed as making possible the increases in the bearing capacities.

Monsanto Texas Expansion

Two major expansions of the capacity of its integrated petrochemical production facilities at Texas City, Tex., have been announced by the plastics division of Monsanto Chemical Co., Springfield, Mass.

A 40-million-pound increase in the rated capacity of the styrene monomer plant will be completed by June, 1958. A 12-million-pound addition to the plant's acetylene capacity will be in operation a few months earlier. Acetylene is one of the basic raw materials for the manufacture of acrylonitrile and vinyl chloride monomer, both produced at Texas City.

By-product gas from the acetylene process is the principal raw material for the Monsanto-operated methanol plant jointly owned with Heyden Newport Chemical Corp.

Facilities to increase acrylonitrile capacity to more than 100 million pounds a year, as well as a substantial addition to Monsanto's polyethylene capacity, have been scheduled.

New Goodyear School Aid

The establishment of a new program of aid-to-education with scholarships, fellowships, and grants, payable during the 1957-58 school year, totaling \$170,000 to the nation's universities, colleges, and technological institutions, has been announced by E. J. Thomas, president of The Goodyear Tire & Rubber Co. and of Goodyear Foundation, Inc.

Recipients of scholarships will be selected by the participating school administrations with the approval of the Foundation. Awards will be made on the basis of academic standing, character, leadership qualities, and financial need.

Other features of the new program are grants to the United Negro College Fund, participation by nationals from Indonesia and the Philippine Islands, and unrestricted grants-in-aid to state foundations of independent colleges where Goodyear has manufacturing operations.

Gro-Cord Acquired

Chase & Sons, Inc., North Quincy, Mass., manufacturer of insulating tapes and other insulating materials for the cable and electrical industry, has acquired a controlling interest in Gro-Cord Rubber Co., Lima, O., producer of work shoe soles and heels.

Gro-Cord Rubber Co. of Canada, Ltd., with facilities at Tillsonburg, Ont., wholly owned by Gro-Cord Rubber Co., will continue to operate as subsidiary, as will Alfred Hale Rubber Co., Inc.

Francis M. Chase, president of the New England firm, has become board chairman and vice president of Gro-Cord, while Edward L. Chase has been named treasurer. Forest Moor will remain as Gro-Cord president.

Seiberling Student Plan

The Seiberling Rubber Co., Akron, O., will offer on-the-job training to third-year mechanical engineering students at the University of Akron. Under the plan worked out in cooperation with the University, students will work at Seiberling and attend school for alternate nine-week periods.

The students will work under the guidance of experienced technical and professional people for their remaining three years of college. The introduction of practical experience into the curriculum will thus lengthen the normal four-year course to five years.

Polyether Urethane Foam

The General Tire & Rubber Co., Akron, O., is discontinuing production of conventional polyester-based urethane foams in favor of a newly-developed polyether-based urethane foam.

Called Polyfoam, the new material, now in volume production at the company's Marion, Ind., plant, is expected to find wide application as a cushioning material in the furniture and automotive industries, in the aircraft, bedding, and clothing industries as an insulating material, and as an underlay.

"Polyfoam will bring to these industries a foam product superior in most applications to other types of urethane and latex foams at a very competitive price," W. O'Neil, president of General Tire, declared.

Extreme light weight, high tensile strength, a high degree of compatibility with other materials, and thermal and sound insulation qualities are reported to be characteristic of the polyether urethane foam.

Said to have been in development for more than two years, Polyfoam will be sold nationally through a new sales organization now being organized by General Tire.

Electron Beam Conclave

The Third Biennial Electron Beam Symposium will be held by the X-ray department of General Electric Co., August 20 and 21, at Milwaukee, Wis. More than 200 American and Canadian scientists are expected to attend.

Included in the two-day affair will be a conducted tour of G-E's new million-dollar facilities in which it fabricates and tests 1,000,000-, 2,000,000-, and 3,500,000-volt electron beam generators and is currently developing linear accelerators of 6,000,000 volts and higher.

Among the speakers will be Robert B. Mesrobian, Continental Can Co., who will talk on "Synthesis in the Modification of Polymers by Radiation," and L. G. Cook, of the G-E research laboratory, whose subject will be "How to Compute Irradiation Source Costs."

UCC Planning Plant

A major chemicals plant is to be built by Union Carbide Corp. in Putnam County, W. Va., according to an announcement by Morse G. Dial, president of the New York, N. Y., firm. Ethanol, ethylene oxide, and isopropanol are three of the more important chemicals to be produced.

The plant will be designed for maximum flexibility to meet changes in the market demands for chemicals. The eight major chemicals producing plant of the company, it will be completed in 1960 and will employ about 500 people. It will be the fourth major chemical unit added since the end of World War II.

Goodyear Retread Plant

The Goodyear Tire & Rubber Co. has opened a new retread and repair plant at Des Moines, Iowa, to serve dealers and customers in the company's Midwest sales region. The plant can produce retreaded tires in all sizes from 6.40x15 passenger to 37.5x33 earthmover.

The one-story plant has a floor area of 28,000 square feet and is 240 feet long and 120 feet wide. More than 30 recap and section repair molds are in the plant's assembly line operation, which includes automatic buffing and tire building machines.

Friction Institute Elects

William J. Vachout, Carlisle Corp., has been elected president of the Friction Materials Standards Institute, Inc., New York, N. Y. George S. Lamson, Thermoid Co., was elected vice president, while Vincent A. Spina, Scandinavian Belting Co., was chosen treasurer. Miss Harriet G. Duschek was named secretary.

Serving on the Institute's board of directors are Frederick C. Weyburne, Bendix Aviation Corp.; Franklin A. Miller, Raybestos-Manhattan, Inc.; Leo S. Sullivan, Russell Mfg. Co.; S. Arthur Smith, Silver Line Brake Lining Corp.; and Richard A. Riley, World Bestos.

Adds to Accopac Line

Five new high density fiber gasketing materials that are said to make possible seals at lower flange pressures have been announced by the industrial division of Armstrong Cork Co., Lancaster, Pa. The materials are additions to the company's Accopac series, which now totals 15.

According to the company, the new materials are compressed to a higher density by an extra calendaring operation, thus closing the natural voids in the material so that seals can be obtained under relatively low flange pressures.

The new materials are: AS-460 Asbestos Accopac, 82-pound density, SBR binder; AD-870 Asbestos Accopac, 82-pound density, neoprene binder; AN-890 Asbestos Accopac, 82-pound density, nitrile rubber binder; CN-808 Accopac, 60-pound density, combination of cellulose fiber, cork, and nitrile rubber; and N840 Accopac, 78-pound density, an impervious structure designed for heavy-duty service, such as in automatic transmissions.

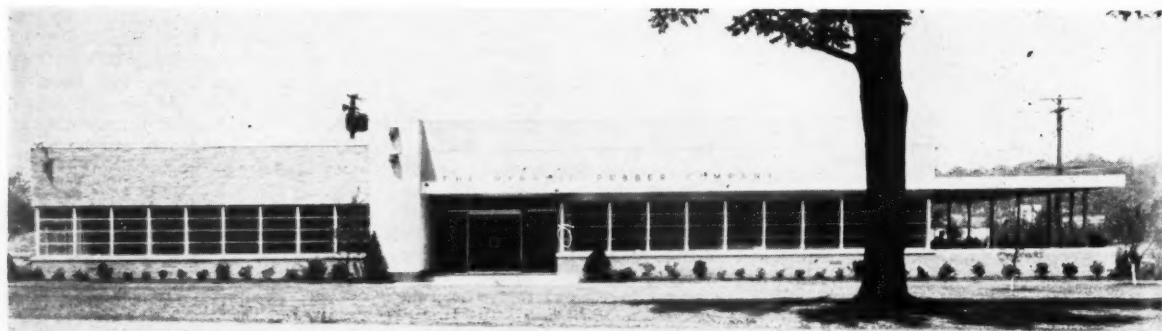
Test Natsyn Truck Tires

The Goodyear Tire & Rubber Co., Akron, O., has conducted a coast-to-coast highway run, testing truck tires built entirely of its own synthesized natural rubber called Natsyn. The tires were said to have performed as well as natural rubber truck tires tested simultaneously.

Goodyear officials pointed out that the cross-country test was the first practical use of the new type synthetic material in actual service conditions such as are experienced by over-the-road truckers.

The test truck-trailer rig employed in the highway run was equipped with natural rubber tires on one side and Natsyn tires on the other. To assure equal test conditions, the tires were switched from one side to the other at regular intervals, with axle positions maintained.

Natsyn rubber is now in the pilot plant stage, company officials said, and will gradually emerge into full production, following the trend of other synthetic rubbers in the past.



THE PYRAMID RUBBER CO.'S NEW OFFICE BUILDING AT RAVENNA, O., OPENED IN EARLY JULY, AND THE firm, manufacturer of Evenflo baby feeding equipment, is now conducting its administration, sales, and traffic operations there. The 15,000-square-foot single-story and basement structure is completely air-conditioned.

Polymer Issues Denial

Polymer Corp., Ltd., Sarnia, Ont., Canada, has called "completely without foundation" an article appearing in the *Financial Post* suggesting that the company might abandon its plans to build a butadiene plant near Red Deer, Alta., in favor of the construction of a new butadiene plant in Sarnia.

Polymer reaffirmed its intention to go ahead with the Alberta project, but said that crystallization of plans must wait until the volume build-up through Trans Canada Pipelines is better known.

At the same time the company said it was currently proceeding with certain changes in its Sarnia butadiene facilities. These changes are being made in order to receive butylenes from the Imperial Oil petrochemical plant when it starts operations in the second half of 1958.

Polymer will receive these butylenes under a long-term contract entered into with Imperial Oil last year. The principal change required to receive this material involves added facilities for the purification of butadiene.

Shell Allylamine Unit

Shell Chemical Corp., New York, N. Y., has begun operation of a new unit to produce allylamines at the company's Martinez, Calif., plant. The facility is designed to manufacture mono-, di-, and triallylamines, experimental chemicals for which scientists have recently found promising commercial uses.

According to L. V. Steck, Shell's marketing vice president, monoallylamine shows promise as a chemical for the manufacture of resins, surface active agents, rubber chemicals, pharmaceutical compounds, and dyestuffs; diallylamine in the preparation of pharmaceuticals and rubber chemicals; and triallylamine, as an intermediate in making quaternary ammonium compounds.

Each of the chemicals has been known in the laboratory for many years. Shell began research on the allylamines in the 1930's and built a pilot plant to produce larger test quantities in the 1940's.

Carwin Polymer Formed

Carwin Co., North Haven, Conn., manufacturer of chemicals, has formed Carwin Polymer Products, Inc., a wholly-owned subsidiary, to develop, manufacture and market industrial materials and end products incorporating the properties of new heat and solvent-resistant polymers that have resulted from Carwin's research program.

These polymers range from plastics to elastomers in both cellular and non-cellular forms, the company said. The polymers are under development as insulating, acoustical, shock absorbing, frictional, sealing, and reinforcing materials.

David E. Cordier, until recently director of the Glendale laboratory of Plaskon Division, Allied Chemical & Dye Corp., has been named technical director of the new company. Ralph Perkins, Jr., is sales manager.

Borden Custom Polymers

A new custom preparation service for the confidential formulation of made-to-order specialty resins and polymers in bulk, suspension, solution, or emulsion is being offered by the monomer-polymer laboratories of the chemical division of Borden Co., Philadelphia, Pa.

Complete laboratory and pilot-plant facilities permit handling of all customer production requirements, including composition, viscosity, solid content, and other individual specifications, the company says. Block and graft polymers and polyelectrolytes such as methacrylic acid/vinyl pyridine copolymers are also a part of the service.

Borden technical personnel are said to be particularly experienced in the preparation of substituted styrene, allyl and diallyl ester, acrylate and methacrylate and vinyl ester copolymer systems.

News About People

Robert L. Toole, since 1954 a senior technical man at the Niagara Falls PVC plant of B. F. Goodrich Chemical Co., Cleveland, O., has been named head of the production department at the plant, succeeding **Dan C. Campbell**, recently transferred to the project engineering department at the company's main offices.

Richard V. Thomas, since 1955 manager of the Los Angeles plant of The Goodyear Tire & Rubber Co., Akron, O., has been appointed assistant to the executive vice president of production for the company. He is succeeded as plant manager by **Marshall F. Gillespie**, Los Angeles

Division A superintendent. Mr. Thomas has been assigned to duties relative to the coordination of Goodyear International Corp. production and development.

F. M. Daley has retired as president of the Sponge Products division of The B. F. Goodrich Co., Akron, O., and is succeeded by **William R. Todd**, who has been vice president since the division was founded as an independent company 34 years ago. Mr. Daley founded the present Shelton Products division of Goodrich as the Sponge Rubber Products Co. in 1923 with Mr. Todd. The firm became a Goodrich division in 1954.



Robert L. Toole



Richard V. Thomas



William R. Todd



Richard M. Howlett

C. A. Carter, G. L. Funk, E. F. Hillenbrand, Jr., P. C. Johnson, R. E. Leech, and C. R. Welter have been promoted to assistant directors of the development department of Union Carbide Chemicals Co., Division of Union Carbide Corp., New York, N. Y. **H. J. Jackson** has been advanced to development area supervisor in the department.

William H. Kibbel, Jr., since 1953 West Coast sales manager for Becco Chemical Division, Food Machinery & Chemical Corp., Buffalo, N. Y., has been appointed manager of market research for the division. Succeeding him is **Vernon E. Moore**, since 1954 a sales representative in the West Coast territory.

Ernest O. Lawrence, professor of physics and director of the University of California's Radiation Laboratory, has been elected a member of the board of directors of Monsanto Chemical Co., St. Louis, Mo. Dr. Lawrence is the winner of the Nobel Prize in physics for 1939.



Henry J. O'Neil

Charles E. Farnsworth has been advanced to assistant manager of the market development division of Enjay Co., Inc., New York, N. Y. **Richard M. Howlett** has been named senior market development engineer in the division. **Brian Casey** has been appointed assistant manager of the company's Paramins division. **R. A. Short** has been named assistant to the manager of Enjay's western division.

Joseph B. Koesterer has been named manager of engineering for the Akron, O., plant of The B. F. Goodrich Tire Co. He replaces **Richard T. Wise**, who has been reassigned to the company's footwear and flooring division, Watertown, Mass.

Ernest Ray Sutton, Jr., has joined the sales staff of Thiokol Chemical Corp., Trenton, N. J., as technical sales representative to the Chicago area.



Ernest Ray Sutton, Jr.

Thonet C. Dauphiné has been appointed manager of product development, plastics, and **Carl I. Gochenour** has been named manager of product development, chemicals, in the product development section of the sales department of Hooker Electrochemical Co., Niagara Falls, N. Y. **Lloyd S. Bovier** becomes administrative assistant to the director of product development.

Thomas Harrison Davies has been appointed director of research at Mellon Institute, Pittsburgh, Pa. Dr. Davies had been the administrative head of the Multiple Fellowship sustained in the Institute since 1952 by Pittsburgh Plate Glass Co.

Francis Edward Klemm has joined Thiokol Chemical Corp., Trenton, N. J., as technical sales representative on polyurethane resins. **Henry James O'Neil** has joined the company's sales staff as technical sales representative in the Detroit area.

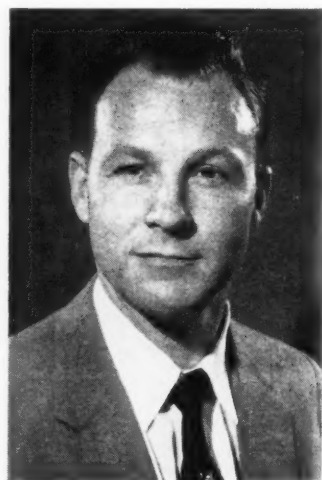


Charles E. Farnsworth

G. E. Kuehn has been made Detroit district manager for Union Carbide Chemicals Co., Division of Union Carbide Corp., New York, N. Y., and is succeeded as Buffalo district manager by **D. F. Swartz**. **Julian Paul**, assistant district manager of the Boston district, succeeds Mr. Swartz as district manager for the Baltimore district.

Sidney T. Webster and **Robert K. Stevens** have joined the research department of the organic chemicals division of Monsanto Chemical Co. at Nitro, W. Va.

Robert B. Boyd has been appointed product manager, organic chemicals, for Hooker Electrochemical Co., Niagara Falls, N. Y. **Fred H. Berggren** has been named product supervisor, chlorate chemicals. Reassigned as sales representatives were **Joseph I. Rue**, to Chicago; **John W. Johnstone, Jr.**, to Niagara Falls; **Charles H. Foster, Jr.**, to Philadelphia; and **James T. Whelan**, to New York.



Francis E. Klemm



Fabian Bachrach

Wilbur K. Tattersall

Wilbur K. Tattersall has been advanced to manager of the grey goods department of Wellington Sears Co., New York, N. Y., succeeding **James A. Horne**, who has retired.

D. H. Merry has been transferred to the St. Louis district sales office of Union Carbide Chemicals Co., Division of Union Carbide Corp., New York, N. Y. Also re-assigned were **T. L. Proctor**, to Detroit; **R. G. Short**, to Cincinnati; **E. A. Vierengel**, to New York; and **A. H. Welle**, to Boston.

Walter J. Tanner has been appointed to the eastern regional sales force of the organic chemicals division of Witco Chemical Co., New York, N. Y.

Fred J. Simon, Midwest district manager for Tyer Rubber Co., Andover, Mass., has been named assistant sales manager, succeeding **Philip L. MacLean**, who was appointed manager of Plastimold, Inc., Middleport, N. Y., recently acquired by Tyer.



Robert S. Savage

Roland Whitehurst has been elected president of Jessall Plastics, Kensington, Conn., continuing as vice president and director of Electric Storage Battery Co., Philadelphia, Pa., the parent company, and head of the Exide Industrial Division. **Monroe G. Smith** has been appointed general manager of Exide, continuing as comptroller of the corporation. **William C. Leingang** has been named general manager of Stokes Molded Products Division, Trenton, N. J., continuing as a member of the management committee of the parent company.

William H. Johnson has been appointed manager of quality control for the textile mills of The Goodyear Tire & Rubber Co., Akron, O.

Edward N. Learner has been appointed sales representative, general chemicals, for B. F. Goodrich Chemical Co., Cleveland, O.



Edward N. Learner

Proctor H. Avon, director of engineering for Monsanto Chemical Co.'s organic chemicals division, St. Louis, Mo., has been granted a leave of absence to attend the fall session of the Advanced Management Program at Harvard University's Graduate School of Business Administration. He is the 36th Monsanto executive to attend similar courses.

Raymond G. Spain has been named head of the elastomer and polymer section of the contract research department of Wyandotte Chemicals Corp., Wyandotte, Mich.

Roland T. Cartledge has joined De Laval Separator Co., Poughkeepsie, N. Y., as manager of its rubber plant.

Robert S. Savage and **Joseph R. Kelly, Jr.**, have been appointed special representatives of the chemical division of The Goodyear Tire & Rubber Co. and have been assigned to the Boston and Cleveland district offices, respectively.



Photo-Art Studio

Richard C. Kremer

Richard C. Kremer, since 1952 factory manager of The Ohio Rubber Co., Willoughby, O., has been advanced to vice president in charge of general sales.

Andrew J. Foglia, **Frederick C. Foster**, and **Roger M. Weil** have joined the staff of W. R. Grace & Co.'s polymer chemicals division, Clifton, N. J., where they have been assigned to polymer research and development. They were last associated with American Cyanamid Co., The Firestone Tire & Rubber Co., and National Lead Co., respectively.

Raymond C. Firestone, president, The Firestone Tire & Rubber Co., Akron, O., has been awarded an honorary Doctor of Laws degree by the University of Akron.

J. B. Harlow, since 1954 Detroit district manager for Union Carbide Chemicals Co., division of Union Carbide Corp., New York, N. Y., has been appointed manager of the Central division.



Joseph R. Kelly, Jr.

Stanley M. Freeman, vice president of Witco Chemical Co., New York, N. Y., has been appointed director of sales of the company's organic chemicals division. He has been associated with the company since 1948.

Harry L. Powell has been promoted to assistant to the vice president in charge of original equipment sales of the Goodyear Tire & Rubber Co., Akron, O. **R. F. Tomkinson** has been advanced to manager of the manufacturers sales department in Akron.

William G. Mueller, formerly Boston mechanical goods district sales manager for United States Rubber Co., New York, N. Y., has retired after 47 years of service with the company.

George W. Ewald has joined J. P. Stevens & Co., Inc., New York, N. Y., as manager of industrial synthetic fabrics sales.

L. R. Ervin has joined Vulcan Rubber Products Division of Reeves Bros., Inc., New York, N. Y., as general sales manager. He was last associated with The General Tire & Rubber Co. as a member of its executive staff and has also served with Ohio Rubber Co.

L. W. Moore, executive vice president of American Oil Co., New York, N. Y., has been elected president, succeeding **Donald J. Smith**, who has retired.

Gordon C. Applequist has been named manager of manufacturers sales for the Detroit division of The Firestone Tire & Rubber Co., Akron, O. He succeeds **D. Joseph Hutchins**, who has retired.

Ronald B. Coffey has joined Monsanto Chemical Co.'s research and engineering division, Dayton, O., and will serve in its research department.

George I. Fetherolf has been named to direct automotive crash pad sales for the engineered products department of The Goodyear Tire & Rubber Co., Akron, O.

L. E. Judd, director of public relations for The Goodyear Tire & Rubber Co., Akron, O., was given a diamond-studded service pin by Chairman of the Board P. W. Litchfield in honor of Judd's completion of 25 years of association with the company.

James S. Sconce, manager of chemical research for Hooker Electrochemical Co., Niagara Falls, N. Y., has been appointed to the newly-created position of technical assistant to management.

Jess W. Meherg and **John P. Urbon**, technical development men with The Goodyear Tire & Rubber Co., Akron, O., have been given the company's Dinsmore Merit Award for technical achievements in 1956.



Neal M. Draper

Neal M. Draper has been appointed assistant to the executive vice president of National Aniline Division, Allied Chemical & Dye Corp., New York, N. Y. He was formerly assistant director of sales with Allied's Solvay Process Division.

Norman J. Rudell has been named manager of the traffic department of Hewitt-Robins, Inc., Stamford, Conn.

George Johnston has become chief chemist of Wooster Rubber Co. (Canada), Ltd., Cooksville, Ont.

Edward J. Bullard has been elected chairman of the board of directors of Bullard Clark Co., Danielson, Conn., and has been succeeded as president and treasurer by **Jack D. Lodge**, formerly vice president and secretary and general manager of the company's Williamsville Buff Division. **J. Edgar Moe** has been named executive vice president and secretary. **William R. Muller**, vice president, has been appointed manager of E. H. Jacobs Northern Division.



Jack D. Lodge

Donald O. Mundale has been reassigned as technical representative for Oakite Products, Inc., New York, N. Y., to the Marion, O., office. **James E. Davenport** has joined the company as technical representative in Rocky Mount, N. C.

William F. Lavelle has been appointed assistant advertising manager of Naugatuck Chemical Division, United States Rubber Co., Naugatuck, Conn.

E. W. Hunnicutt has been appointed New England district sales representative for the Campeco Division of Chicago Molded Products Corp., Chicago, Ill.

J. Howard Brown has been named research manager in charge of phosphorus chemistry research and of the analytical and physical chemistry laboratories of Hooker Electrochemical Co., Niagara Falls, N. Y. **Morton S. Kircher** becomes manager of inorganic and electrochemical research and of the company's Virgo laboratory. **Jack S. Newcomer** has been named manager of organic chemical research.

William B. Watson, since 1953 vice president and factory manager of Seamless Rubber Co., New Haven, Conn., has been advanced to executive vice president. **Albert H. Kuhn** has been promoted to factory manager and has been succeeded as assistant factory manager by **Paul Reilly**, formerly assistant development engineer.

George C. Sheldon has been named operating manager for the Peabody operation of the coatings and adhesives department of the chemical division of Borden Co., New York, N. Y.

Des Seymour and **W. L. Leach** have been named sales representatives to the Ontario and Quebec areas, respectively, for Cabot Carbon of Canada, Ltd., Toronto, Ont.

George Zeigler has been made chief chemist at the Brantford, Ont., plant of Gates Rubber Co. of Canada, Ltd.

William Bobbie has been appointed plant engineer of B. F. Goodrich Canada, Ltd., Kitchener, Ont., Canada. **R. A. Woodrow** has been named personnel manager.

Rolf Kaufman has been appointed assistant vice president of Wellco Shoe Corp., Waynesville, N. C. He joined the company in 1956.

R. S. Abrams has been appointed general manager, and **L. J. Sinnott** has been named general sales manager of the silicones division, Union Carbide Corp., New York, N. Y. Mr. Abrams, who joined the company in 1941, was most recently manager of production and engineering for the division. Mr. Sinnott was formerly sales manager for the silicones department of Linde Air Products Co., a UCC division.

NEW WORLDS
TO EXPLORE...

...with

'Sharples' brand Synthetic
ORGANOSULFUR
Chemicals

Pennsalt Chemicals Corporation—a leading supplier of both organic and inorganic chemicals for more than 100 years—is now producing, in high-volume continuous processes, 'Sharples' brand synthetic Organosulfur chemicals directly from unlimited basic mineral sources.

These new petrochemical "building blocks", synthesized from elemental sulfur, natural gas and petroleum, are: Methyl Mercaptan, Ethyl Mercap-

tan, n-Butyl Mercaptan, n-Octyl Mercaptan, Tertiary Dodecyl Mercaptan, Thiophene and Ethylmercaptoethanol.

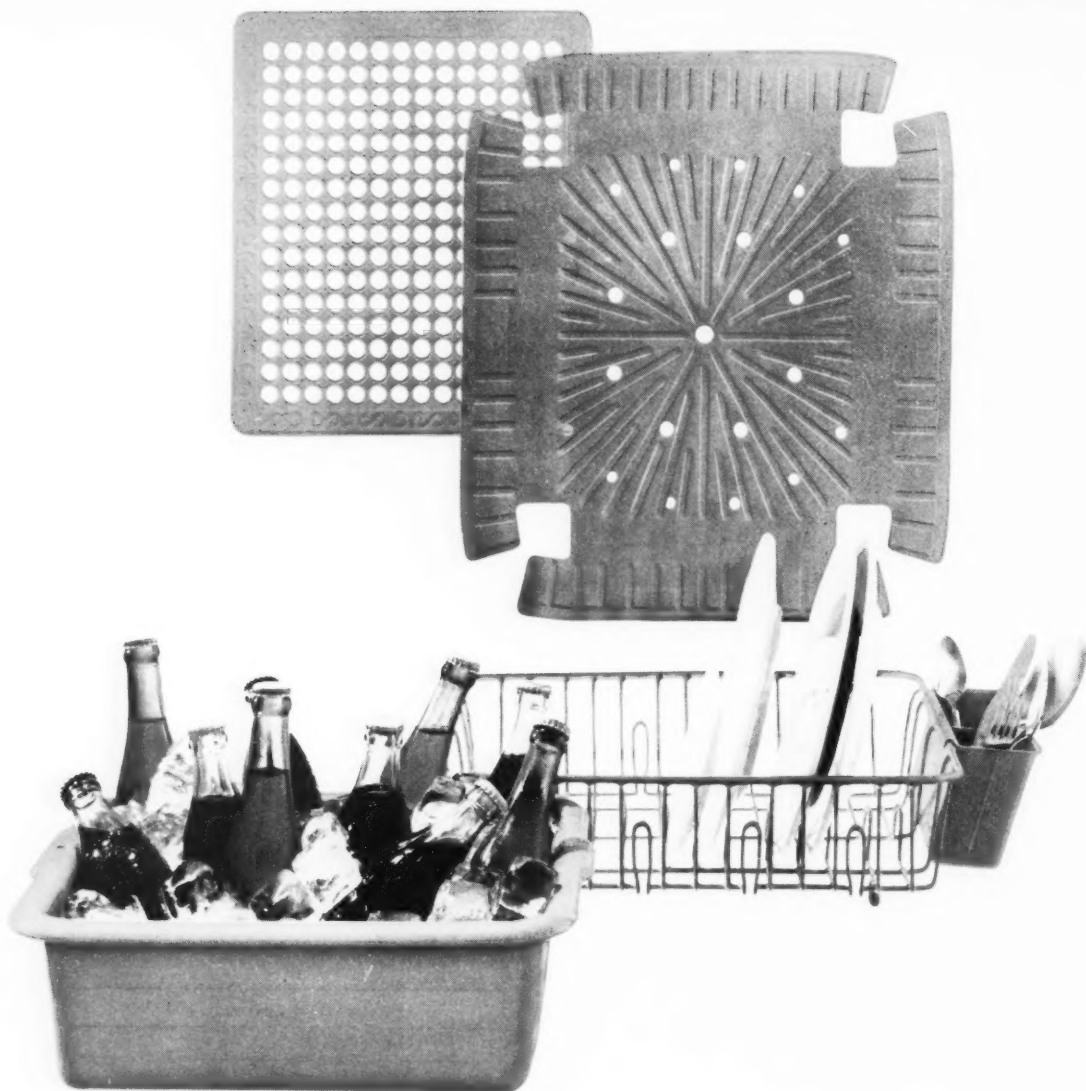
Investigate the 'Sharples' brand synthetic Organosulfur chemicals for better starting points and pathways to new intermediates and improved products. Call your nearest Pennsalt district office or write to Pennsalt direct.



INDUSTRIAL DIVISION
PENNSALT CHEMICALS CORPORATION

3 Penn Center, Philadelphia 2, Pa.

New York • Pittsburgh • Cincinnati • Akron • Chicago
Appleton • Detroit • St. Louis • San Francisco • Los Angeles
Airco Company International, New York • Pennsalt of Canada: Hamilton, Ontario



Pretty Products molds attractive Prettyware items like these in colorful turquoise, blue, green, pink, red, yellow, black, and white.

Pretty Products pretties housewares with Calcene®

It takes rainbow hues . . . brights and shadings and placid pastels . . . to sell today's color-craving shopper. Getting those homemaker-catching colors into rubber articles led volume housewares producer Pretty Products Inc. of Coshocton, Ohio, to Calcene.

This pioneering manufacturer needed a white reinforcing pigment capable of imparting high hot tear strength and other desirable physical properties at low compounding cost. Columbia-Southern's fine particle precipitated

calcium carbonate met these demands. Calcene is used by Pretty Products not alone in housewares, but also in formulation of auto accessory floor mat and bathing cap stocks—in effect, finding application from top to toe.

Calcene TM or Calcene NC (not coated) may well answer superbly *your* needs for economical compounding to provide such properties as higher tear strength, low modulus, good tensile strength, increased abrasion resistance. For more information and free working

samples, contact Columbia-Southern Pigments Department, Room 1929W, One Gateway Center, Pittsburgh, or any of our 14 District Sales Offices.

**COLUMBIA-SOUTHERN
CHEMICAL CORPORATION**
SUBSIDIARY OF PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER • PITTSBURGH 22 • PENNSYLVANIA



DISTRICT OFFICES: Cincinnati • Charlotte
Chicago • Cleveland • Boston • New York
St. Louis • Minneapolis • New Orleans
Dallas • Houston • Pittsburgh
Philadelphia • San Francisco

IN CANADA: Standard Chemical Limited
and its Commercial Chemicals Division

William H. Kramer has been appointed field representative for the foam products sales division of The Goodyear Tire & Rubber Co., Akron, O.

George Graham has joined Stein, Hall & Co., Inc., New York, N. Y., as sales representative at its St. Louis branch.

Allen C. Raby has been appointed southern sales representative for Vulcan Rubber Products Division of Reeves Bros., Inc., New York, N. Y.

George G. Pinheiro has joined Acme-Hamilton Mfg. Corp., Trenton, N. J., as advertising manager.

Henry Davis, Jr., has been advanced to assistant manager of branch sales for the mechanical goods division of United States Rubber Co., New York, N. Y. He joined the company in 1945.

Charles Y. Cain has been named administrative assistant to the general sales manager of the Durez Plastics Division of Hooker Electrochemical Co., North Tonawanda, N. Y.

Charles H. Hahn has been appointed western trade sales manager for the Firestone Tire & Rubber Co., Akron, O., and is succeeding as central sales division manager by **Barrett Kirkendall**.

American Synthetic Rubber Co.'s plant at Louisville, Ky., has completed a \$3,500,000 expansion program which will increase its annual production capacity by about 25,000 long tons of synthetic rubber. New reactor, recovery, and process facilities were built.

General Electric Co., service shops department, New York, N. Y., has increased the repair prices on most electrical apparatus by about 4½% in its 54 repair centers throughout the U. S.

Goodyear Aircraft Corp., Akron, O., is developing a two-seat version of its inflatable plane, an inflatable aircraft made of The Goodyear Tire & Rubber Co.'s Airmat, a two-walled rubberized fabric connected by nylon threads, which composes the one-piece wing, tail assembly, and cockpit, and a rubberized fabric cigar-shaped fuselage.

Skeist & Schwarz Laboratories, Inc., Newark, N. J., has been formed to conduct sponsored research, market surveys, plant design and layout, patent investigation, and process and product development for the plastics and textile industries, particularly in the field of polymer-textile chemistry.

Army Ordnance Tank-Automotive Command, Detroit, Mich., is formulating details of a new policy whereby commercial tire rebuilders will be given a major share of military tire rebuilding now being done by U. S. Army Ordnance shops. Pre-award surveys of bidders' facilities will be made.

B. F. Goodrich Aviation Products, Akron, O., has developed a full pressure high altitude suit for U. S. Navy pilots in supersonic aircraft capable of ascent into the stratosphere. The rubber and nylon suit contains its own communication, oxygen, and ventilation systems.

The Firestone Tire & Rubber Co.'s new Noblesville, Ind., Airide Spring plant has gone into full-scale production. The air springs produced at the facility will be offered as optional equipment on several 1958-model cars.

New York Belting & Packing Co., New York, N. Y., a subsidiary of United States Rubber Co., is producing Gilmer "timing" belts for New England Machine & Tool Co.'s Electronic Template and Cam Machine which can shape intricate cams at speeds from 48 to 11,500 revolutions per minute. The flexible transmission belt is made of rubber, fabric, and steel, has teeth, and turns in grooved pulleys to give non-slip power transmission. Pratt & Whitney Co. distributes the machine.

Hodag Chemical Corp., Chicago, Ill., has put on the market a new HC-300 series of "instant" antifoams for chemical and industrial processing. The antifoams, available in flake or powder form, immediately emulsify upon addition to water.

News Briefs

C. G. Sargent's Sons Corp., Graniteville, Mass., has appointed John Law & Co., Chicago, Ill., as sales engineering representatives to the Chicago, South Bend, and Milwaukee area for its line of dryers, coolers, feeds, and other rubber processing machinery.

B. F. Goodrich Co. is building a \$400,000 distribution center on a recently purchased 125,000-square-foot tract on Jefferson Highway in New Orleans, La. The center, to contain 55,000 square feet of floor space, will house offices, warehouse facilities for tires and industrial products, and a tire recapping plant.

Monsanto Chemical Co., St. Louis, Mo., has expanded by 10% its production capacity for maleic anhydride, a resin material which is the chief ingredient in the manufacture of alkyd-based paints, other hard resin surface coatings, and polyester resins.

Barrett Division, Allied Chemical & Dye Corp., New York, N. Y., has appointed three distributors to handle its Poly-Lease 77 polyethylene mold release for rubber and plastic molded products. They are Thalco, Los Angeles, Calif., and West Coast Plastics Distributors, Inc., Culver City, Calif., for the Southwest area; and Ren Plastics, Lansing, Mich., for the Midwest and Eastern areas.

Dow Corning Corp.'s Silastic Type K Interlayer, a silicone rubber said to be the first transparent rubber of any kind on the market, is being used as the interlayer in the windshield of the U. S. Air Force's delta-winged Convair B-58 supersonic bomber. Conventional plastic interlayer would melt in the frictional heat developed while the aircraft is in flight.

Monsanto Chemical Co.'s Santonox non-staining antioxidant for polyethylene plastic, said to be about four times more efficient than similar compounds, has been accepted by the Food & Drug Administration as safe to use in high-pressure polyethylene films for food packaging. Developed by the firm's organic chemicals division, Santonox is a purified dialkyl phenol sulfide which has been marketed by the company as a rubber antioxidant under the name Santowhite Crystals.

Darlington Chemicals, Inc., Philadelphia, Pa., has received a small consignment of light magnesium carbonate, light magnesium oxide, and magnesium hydroxide from the cargo of the recently-arrived Mayflower II. The chemicals were produced by Darlington Chemicals, Ltd., Darlington, England.

Naugatuck Chemical Division, U. S. Rubber Co.'s Kralastic rubber/plastic material, formed two years ago into a pipe system for the 100-million-gallon-a-day Elm Fork Water Purification Plant of the City of Dallas by Southwestern Plastic Pipe Co., Mineral Wells, Tex., has performed successfully without sign of deterioration in carrying corrosive chemicals, Naugatuck reveals.

The Firestone Tire & Rubber Co.'s subsidiary, Ravenna Arsenal, Inc., which operates the Ravenna (Ohio) Arsenal, presented to the U. S. Army the six millionth 155 millimeter artillery shell and the one millionth eight-inch shell to be loaded there.

Marbon Chemical Division, Borg-Warner Corp., Chicago, Ill., has reduced the price of its Cyclocac resin in pellet form by 7¢ a pound and in powdered form by 5¢ a pound.

The Firestone Tire & Rubber Co.'s Pottstown, Pa., plant has completed more than 7,800,000 man-hours without a lost time injury, bettering the previous company safety record of 7,722,000 no-injury man-hours established at the Memphis, Tenn., plant.

B. F. Goodrich's Koroseal food-handling conveyor belts, installed six months ago in the Los Angeles plant of Frito Co.-Western Division, have stood up successfully to attack by warm cooking oils which previously caused failure in conventional belts within a three month period, the Akron rubber company reveals.

Naugatuck Chemical Division, U. S. Rubber Co.'s Kralastic rubber/plastic material has been used to make 40 miles of extruded pipe which compose the newly-installed underground sprinkler system for the fairways of the Torrey Pines Mesa Golf Club, San Diego, Calif.

Marbon Chemical Division, Borg-Warner Corp., Chicago, Ill., is offering externally lubricated Cylolac pellets for injection molding which are said to effect faster and more efficient moldings.

B. F. Goodrich Chemical Co.'s Geon 81576 polyvinyl jacketing material is being used in the recently-made-available telephone cords that cannot twist or tangle, the company reveals.

Monsanto Chemical Co., plastics division, Springfield, Mass., has introduced Lustrex Hi-Test 89, a rubber-modified styrene polymer combining high resistance to heat distortion with high impact strength. It is available in two formulations: for injection molding and for profile extrusion.

The Firestone Tire & Rubber Co., home and auto supply division, Akron, O., has announced the incorporation of a cobalt and arsenic formulation in the company's Extra Life and Supreme Power batteries which is said to give positive protection against overcharge.

B. F. Goodrich Industrial Products Co., plastic division, Marietta, O., has sent a team of technicians on a 15-month nationwide tour to conduct demonstrations in plants on the properties, fabrication, and installation of Koroseal rigid vinyl pipe and sheeting.

Plastics Exposition Set

The Eighth National Plastics Exposition will be held at the International Amphitheatre, Chicago, Ill., November 17-21, 1958, in conjunction with a National Plastics Conference at the Hotel Morrison, it has been announced by C. Russell Mahaney, president of The Society of the Plastics Industry, Inc., New York, N. Y., sponsor of the two events. SPI committees are being set up to conduct the affairs.

Obituaries



Donald Arthur Comes

Donald Arthur Comes

Donald Arthur Comes, vice president and general sales manager of Farrel-Birmingham Inc., Ansonia, Conn., died suddenly of a heart attack at his home in Woodbridge, Conn., July 14.

Mr. Comes was first connected with Farrel-Birmingham in 1922 as a sales representative in the New Jersey area. He had a wide circle of friends in industry and was especially recognized in the rubber and plastics fields for his important work in connection with the Banbury mixer. In 1943, he replaced F. H. Banbury, the inventor of this mixer, as head of the Banbury mixer department, with offices at the Ansonia headquarters of the company. He was made general sales manager in 1954 and was elected vice president later the same year.

The deceased was born in Hackensack, N. J., April 22, 1895.

Services were held July 16, at the Lewis Funeral Home in Derby, Conn. Burial was in the Milford Side Cemetery, Woodbridge.

Mr. Comes is survived by his wife, two sons, three grandchildren, a brother, and a sister.

Howard A. Swearingen

Howard A. Swearingen, president of Aluminum Flake Co., Akron, O., died July 10 at a Cleveland, O., hospital.

Mr. Swearingen became a certified public accountant in 1915, the youngest in Ohio. At that time he joined Aluminum Flake as its auditor. In 1945 he succeeded the late Francis Seiberling as president of the company.

Mr. Swearingen was treasurer of Lakewood Country Club, a member of Al Koran Shrine, member of American Institute of CPA's, and of the Lakewood Christian

Church. He was also a 32nd degree Mason.

The deceased was born in Cleveland on September 10, 1893. He was a graduate of old Central High School, Cleveland.

Funeral services were held at Daniels Funeral Home, Lakewood, July 13. Interment took place at Lakewood Memorial Park Cemetery, Rocky River, O.

Mr. Swearingen is survived by his wife, a son, three daughters, and eleven grandchildren.

Financial

Allied Chemical & Dye Corp., New York, N. Y. First half, 1957 net income, \$22,087,598, equal to \$2.23 a capital share, compared with \$25,519,092, or \$2.57 a share, in the 1956 half; sales, \$349,483,813, against \$341,684,459.

American Cyanamid Co., New York, N. Y. Six months to June 30, 1957: net earnings, \$23,685,198, equal to \$2.24 a share, against \$23,002,093, or \$2.17 a share, in the like period last year; sales, \$259,127,000, against \$252,885,000.

Collins & Aikman Corp., New York, N. Y. Quarter ended June 1, 1957: net loss, \$131,837, contrasted with net loss of \$167,735 in the 1956 period.

Diamond Alkali Co., Cleveland, O. January 1-June 30, 1957: net profit, \$4,680,412, equal to \$1.73 a share, compared with \$5,516,977, or \$2.04 a share, a year earlier; sales, \$65,207,122, against \$64,169,572.

General Tire & Rubber Co., Akron, O., and subsidiaries. Six months ended May 31, 1957: net profit, \$5,814,861, equal to \$3.38 a common share, compared with \$4,027,431, or \$2.41 a share, in the like period last year; net sales, \$205,968,169, against \$177,796,438.

Hooker Electrochemical Co., Niagara Falls, N. Y., and wholly owned subsidiaries. Six months ended May 31, 1957: net profit, \$4,596,200, equal to 70¢ a share, contrasted with \$6,187,800, or 94¢ a share, in the 1956 months; sales, \$53,765,600, against \$55,131,500.

Correction

In the June issue of RUBBER WORLD, page 400, the name of D. A. Stivers, Minnesota Mining & Mfg. Co., was incorrectly spelled as Stirers. Mr. Stivers was one of the panelists at the Detroit Rubber & Plastics Group meeting of April 12.

News from Abroad

Germany

Novodur—New Plastic

Novodur is a butadiene-styrene-acrylonitrile copolymer similar to Kralastic,¹ which has been developed by the Farbenindustrie Bayer A. G., Leverkusen, and was shown for the first time at the Plastics Fair in October, 1955. Novodur is supplied in the form of granules of a beige-yellow tint, but can be colored. From the accompanying table it is seen that Novodur, containing 10% titanium dioxide, compared with block-polymerized styrene, polystyrene modified with 14% butadiene, and copolymer of styrene and 26.5% acrylonitrile is an unusually tough plastic, with very high resistance to impact, shock, and abrasion:

	Polystyrene	Modified Polystyrene	Copolymer Styrene/Acrylonitrile	Novodur
Density	1.05	1.05	1.08	1.12
Impact strength, kg/cm ²	20	unbroken	18	unbroken
(Notch) strength, kg/cm ²	2	12	2	20
Flexural strength, kg/cm ²	1000	500	1400	650
Compressive strength, kg/cm ²	900	400	1250	390
Tear resistance, kg/cm ²	400	310	650	350
Elongation, %	2-3	>25	2-3	30
Shore hardness, Scale D	88	83	93	84
Softening point:				
Vicat °C.	88	86	115	105
Martens °C.	70	68	84	77
Swelling in benzene, after 8 days at 20 °C, %	unstable	unstable	0.0	0.1
Dielectric strength, kv/mm	56	32	22	22
Volume resistivity, cm	>10 ¹⁶	about 10 ¹⁵	1 x 10 ¹²	6.4 x 10 ¹¹
Dielectric constant				
50 Hz*	—	—	3.4	6.2
10 ⁶ Hz	2.4	2.4	3.2	4.7
Loss factor tgδ				
50 Hz	—	—	0.016	0.100
10 ⁶ Hz	2 x 10 ⁻⁴	—	0.019	0.150

* One cycle per second

In practice, it is said, thermal qualities are much better than the Vicat and Martens softening points indicate: thin-walled, filled bottles underwent no deformation of any kind after weeks of storage at 80° C., and though mechanical properties deteriorate in cold, values for impact (notch) resistance at 0 and -10° C. are still higher than for comparable plastics at ordinary temperature.

Electrical properties are inferior to those of ordinary polystyrene so that Novodur is only recommended for low-tension techniques. Concentrated organic and mineral acids destroy Novodur or at least cause it to swell considerably; many solvents, like esters, ketones, aromatic or halogenated hydrocarbons, carbon disulfide, ethers, also cause marked swelling. On the other hand, Novodur resists concentrated and dilute alkalies and dilute acids, aliphatic hydrocarbons, and fats and oils.

Novodur is stabilized against the action of atmospheric oxygen on the butadiene

¹ Internally plasticized copolymer of butadiene, styrene, and acrylonitrile, Naugatuck Chemical Division, United States Rubber Co.

components by the incorporation of anti-oxidants during its preparation; hence it retains its good mechanical properties even under unfavorable conditions. When subjected to strong sunlight or the prolonged effect of diffuse daylight, however, white or ivory-colored products become yellow. Novodur has been tested for physiological effects and has been proved harmless.

The material can be processed without difficulty on all the usual machines for thermoplastics; care must be taken, however, to maintain proper temperatures in extrusion, injection and blowing operations; pin-point gating is not recommended. Semi-finished products can be machined,

welded, hot-formed; because of its toughness even at high temperatures. Novodur sheet 0.5-1 millimeter thick can be much more successfully vacuum-formed than similar films of other plastics.

So far German practical experience with Novodur is still limited. Some important oil companies, however, have been testing

Novodur pipe and have pronounced it useful for surface transportation of low-paraffin petroleum. This piping is also used for conveying salt water and is said to be preferred to other plastic piping for this purpose, and this application is growing. Many of the applications developed in America for Kralastic are now being tested on Novodur. At present, the material seems to have been recommended chiefly for injection molding of articles where high shock and impact resistance and low abrasion are important.

Rubber Goods Output Down

The rapid progress made by the German rubber industry since 1948, which reached an all-time high in 1955, came to a halt in 1956. Some lines even showed a marked recession which, though partially offset by increases in others, brought the total production figure for the year to 382,660 tons, or 1.2% under the record 387,349 tons in 1955. The setback was chiefly due to the 13% drop in the output of truck tires mainly for replacement purposes, which could not be compensated for by the rise of 14% in passenger-car tires and of 2.8% in cycle tires. There was a further decline in the output of motorcycle tires, showing that the switch from motorcycles to small automobiles by factory and office workers noted in 1955, continued in 1956 and was partly responsible for the higher figure for automobile tires. Tire repair material rose by 13½%. Taken all together, the tire industry accounted for a total of 176,479 tons in 1956, against 181,295 tons in 1955, or 2.7% less.

The total for all other rubber goods in 1956, at 206,181 tons, against 206,054 tons the year before, was practically unchanged. Sharp reductions, however, took place for footwear and rubberized fabrics and articles made from them. In the latter case, fashion and the growing popularity of plastics caused the difference. The decline in the footwear industry, on the other hand, is ascribed to considerably increased imports from countries with a very low standard of living or where industry is state-controlled so that price is no object, and German manufacturers can easily be undersold.

Table 1 shows outputs of the different classes of rubber goods during 1956, 1955 and 1950 in tons.

Consumption figures of raw materials

TABLE 1

	1950	1955	1956
Cycle tires	19,502	16,241	16,701
Motor cycle and automobile tires	26,316	54,270	59,839
Truck and special tires	44,151	94,429	81,432
Tire repair material	7,829	16,355	18,507
Total	97,798	181,295	176,479
Heels and soles	22,279	43,889	43,391
Rubber footwear	10,912	15,202	12,302
Beltting	6,139	10,836	10,437
Lined hose	7,461	12,807	12,342
Other mechanical goods of soft rubber	30,580	63,054	66,182
Surgical soft rubber goods	4,627	15,951	16,611
Rubberized goods and products thereof	4,118	7,467	6,717
Other soft rubber goods	11,969	26,252	27,688
Hard rubber goods	5,233	10,596	10,511
Total	103,318	206,054	206,181

by the rubber industry reveal a drop of 11.6% for natural rubber (from 134,178 tons in 1955 to 118,648 tons in 1956), but an increase of 40.8% in synthetic rubber (from 24,216 to 34,098), and 41.4% of plastics (from 6,475 to 9,154 tons); the use of reclaim and old rubber rose from 42,517 to 44,788 tons, 5.3% more in 1956 than in 1955.

The total number of persons employed by the industry averaged 81,426 last year, against 79,186 the year before, so that productivity per worker apparently fell off somewhat.

Producing Nylon Cord

An installation for the production of nylon cord, built by Vereinigte Glanzstoff Fabriken, A. G., at its works in Obernburg a. M., began operating early in May. To start with, output will be kept low and will go chiefly to tire manufacturers for experimental purposes.

Giant Four-Roll Calender

The biggest four-roll calender yet produced in East Germany was reportedly tested at VEB Reifenwerk, Fürstenwalde, Fürstenwalde/Spree, last year. The unit, constructed by a machinery factory in Chemnitz, is said to have run with a speed of 36 m/min. (about 118 feet) while rubberizing a web 160 cm. wide (about 64 inches); this is said to be between three and four times the rate hitherto customary, that is 9-11 m/min. (about 30-36 feet).

Malaya

Recommendations Extensive In Final Blackman Report

The Blackman report has finally been released for publication. This is the report of the committee of British experts, headed by Prof. G. E. Blackman, of Oxford, which the Rubber Producers' Council had appointed last year to inquire into the competitive position of natural rubber.

As already revealed, the most important recommendations made aim at increased research and lower prices. The Malayan rubber industry is advised to intensify research and to build up a large reserve fund for research development; an increase in the rubber export cess from its present level of 0.5-cent to 0.75-cent per pound (Straits currency) is recommended to provide additional funds for these purposes. At present, the cess produces \$6.-600,000 (Straits) annually for research, which, the report points out, is in no relation to what the American industry spends on synthetic rubber research.

At the same time, the report suggests wiser spending of funds; expenditure on publicity and propaganda by the Natural Rubber Development Board and the Natural Rubber Bureau should be reduced;

development work should be centralized; field experiments at the Rubber Research Institute should be critically examined, and only those of real scientific merit continued. On the other hand, the staff of the RRI should be brought up to full strength, and higher salaries and better terms offered scientific workers in order to attract top men.

Research will have to aim at the production of a better natural rubber at a price low enough to give it preference over synthetic rubber or plastics, the report warned; it contrasted the rapid development in the latter fields with work of the natural rubber industry which has not seriously reexamined for half a century the basic principles of vulcanization. Natural rubber must be improved; its known deficiencies eliminated, and the special qualities of synthetic materials duplicated wherever possible; the cost of production must be kept at a low level so that good-quality rubber could be profitably sold at not more than 60 Straits cents a pound, and possibly 55 cents (f.o.b.).

The frequently heard opinion that price fluctuations were aggravated by undue gambling in futures in the Singapore market was referred to, as well as the irritation felt over the fact that no legislation had been attempted to restrict gambling. Complaints by overseas buyers about discrepancies in grades shipped from Singapore were mentioned, with the remark added that: "It would be very much in the interest of the plantation industry if pressure could be brought to bear to strengthen the hand of the Malayan Rubber Export Registration Board."

No special comment from the industry on the report has yet become available, but it is thought likely that the main recommendations will be accepted—with suitable modifications.

Brokerage Fee War

A price-cutting war on brokerage fees that has led to a difference of as much as 14-cent per pound in the price of rubber with a broker who cuts fees or foregoes them altogether to attract business followed the dissolution in late June of the Singapore Rubber Brokers' Association. The Association seems to have collapsed because it was unable to enforce rules on brokerage rates among members or to stop the activities of numerous firms of "five-ton brokers" which have sprung up in recent years, so that in effect members who were trying to abide by rules were being penalized.

The practice of undercutting brokerage charges, according to some, actually began about six months ago, when the rubber market was weak, but has finally come out into the open. The only effective solution for the situation most brokers believe is active interference by the Singapore Chamber of Commerce Rubber Association in cleaning up the mess and setting up a new brokers' association.

A new note, however, has been introduced by the statements of a well-known Chinese rubber broker who demanded full membership rights in the SCCRA for all races. At present Asians are admitted only

as associate members, he stated, with no rights but paying their subscription.

"After all," he is quoted as saying, "all races will have to stay in harmony as one family after independence. If any community tries to bar any other race from any proper activity, it will spread disharmony which will be detrimental to the progress of Singapore."

The continuation of an exclusion policy would force the Chinese to quit the SCCRA and form a similar organization of their own, he warned.

From the fact that this spokesman then went on to name prominent Chinese rubber men as leaders of such a body, it would seem that the Chinese community has seriously considered such a contingency.

UPAM Report for 1956

The figures on replanting and new planting by estates in Malaya during 1956, presented in the annual report of the United Planting Association of Malaya for the year, show the substantial increase to 93,000 acres, from 67,000 acres in 1955; 1957 is expected to show a total of 100,000 acres of replanting and new planting. While the government replanting scheme has been accelerating activities by estates in these fields, it is worth noting that estates had replaced about 47% of old rubber with high-yielding material before the scheme came into effect and that more than half the rubber produced in the Federation came from areas improved before and after the war. No progress was made in the production of special types of rubber in 1956, and, also, less interest was shown in T. C. rubber than in 1955.

In view of the coming independence of Malaya, the remarks on the status of terrorism in Malaya at present deserve mention. Communist terrorism is still a factor to be reckoned with, the report shows, and while there is admittedly an improvement as a whole, there are nevertheless still districts where terrorist activities have abated little, if at all. In 1956 four more rubber planters were killed on their estates; terrorism continues to gain new recruits and more important, still, to get aid in clothes and food.

The emergency is now nine years old, and obviously the handling of the situation must be looked into, the report emphasizes. A disturbing fact that has come to light is that Communists have usually surrendered not because they were disillusioned with Communism, but because they lacked food.

Rhodesia

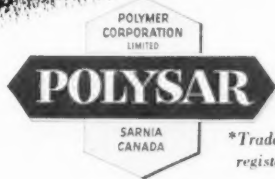
Construction will shortly be started on a tire factory in Rhodesia by Dunlop Rubber Co. It is expected that about 18 months after building commences, it will be possible to begin to supply the growing demand of the area for tires for cars, trucks, buses, tractors, cycles, and motorcycles, as well as for retreading material.

Problem:

North Western Supply Company, of Vancouver, needed a sealing compound to form a perfect and permanent seal between glass and aluminum in curtain wall construction. It had to remain flexible at temperatures which cause varying expansion, to resist weather and allow constant movement between surfaces without deterioration.

Solution:

Polysar Butyl 301 proved to be the answer to North Western's exacting sealing problem. As the base for Norwescoseal 566, Polysar Butyl 301 imparts the essential qualities of permanent adherence in all weather between the sealing compound and materials of varying physical qualities under repeated flexing.



*Trade mark
registered

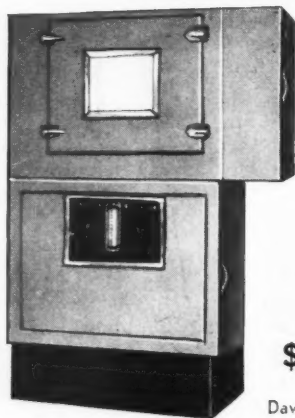
POLYMER CORPORATION LIMITED
SARNIA • CANADA

There is a wide variety of Polysar synthetic rubbers from which to select the one best suited to a particular application. The Sealant, based on Polysar Butyl 301 is just one example of the many uses for these rubbers. In countless industries—myriads of products are being improved and enlarged upon by Polysar synthetic rubbers. Regardless of your field, it may be that Polysar synthetic rubber can solve your technical problem. Write to our Sales and Technical Service Division, Polymer Corporation Limited, Sarnia, Canada.

***POLYSAR RUBBERS — General Purpose**
(hot, cold and oil extended) . . .
Special Purpose . . . Latexes . . . Butyl.



Model 700-1 OZONE TEST CHAMBER



\$2980.00

f. o. b.
Davenport, Iowa

Simple to operate

**ECONOMICAL
RELIABLE**

SPECIFICATIONS

Ozone Concentration Range: 15 to 1,000 pphm

Temperature Range: 5° below ambient to 200° F $\pm 1^\circ$ F.

Air velocity over sample: 2 feet/second

Chamber dimensions: 20" x 20" x 25" (5.7 cubic feet)

Floor space required: 54" x 28 1/2"

Power requirements: 110-115 volts, 60 cycle, AC

PARTIAL LIST OF USERS

Goodyear Tire and Rubber Co.
B. F. Goodrich Company
General Tire and Rubber Co.
U. S. Rubber Company
Mogul Rubber Company
International Latex Corp.
Chrysler Corporation
General Motors Corp.
Thiokol Chemical Corp.
Geauga Industries Company

FOR FURTHER INFORMATION

WRITE

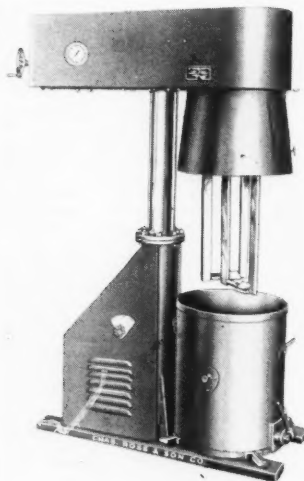


**mast
development
company, inc.**

DAVENPORT, IOWA

NEW EQUIPMENT

Ross Changeable Can Mixers



#130 CDM can mixer

A new series of heavy-duty changeable can mixers has been announced by Charles Ross & Son Co., Brooklyn, N. Y. Said to be precision engineered to develop the greatest shearing and dispersing action in mixing paste materials these mixers are available in sizes from one- to 150-gallon working capacity. They employ intensive double planetary mixing action whose efficiency reduces mixing time to a minimum, according to the company. Each stirrer revolves on its own axis, while both stirrers are revolved at a slightly slower speed around the can.

The mixers feature simplified vertical hydraulic lift for ease in cleaning stirrers. The non-rotating can is completely enclosed during mixing for maximum safety, while retarding creation of dust or evaporation of solvents. The cover has hinged observation or charging port and includes a detachable spout for safe adding of materials during mixing. A wide range of stirrer speeds can be obtained by adjusting a hand-wheel at the back. Optional features include a dolly truck, outlet gate, jacketed can, tachometer, and self-adjusting floating-type outer scraper arm.

Iddon Rubber and Plastic Mills

A line of rubber/plastic mills manufactured by Iddon Bros., Leyland, England, is available in the United States and Canada through Wilmod Co. Rubber Division, Toronto, Ont., Canada. The mills range from 6- by 12-inch laboratory single- and double-gear two-speed machines to 26- by 84-inch and larger for special purposes. All standard equipment can be supplied, Iddon says, such as motorized adjustment, flood lubrication, water-cooled bearing blocks, drilled rolls, adjustable guides, scrapers, and hand or power operated facilities. Either the standard double-helical reducer or the right-angle space saving types of drives are available.

Called of special interest to U. S. and Canadian manufacturers is the heavy-duty single-gear mixing mill here illustrated. The unit is motor driven through double-helical reduction gear and mounted on a sub-frame fitted with vibro-insulators. With worm-operated scraper on back roll, the rolls are 22 inches in diameter. The mill is fitted with the Lunn safety device which stops the mill when more than 40 pounds of pressure are applied by the operator to a pressure bar running across the roll face. The switch-off is therefore automatic if the operator is caught in the bank of rubber or plastics.

Another feature is a one-piece steel bedplate carrying the mill, reducer, and motor. The mill requires no heavy foundation. The mill roll height is different from that used generally by American

4

NEW SUN RUBBER PROCESS AIDS extend an already versatile list of products to fill all your processing requirements. Sun Oil Company's industry-leading list of high-quality products grows and grows to give you greater flexibility and economy in compounding and processing natural and synthetic rubbers.

PRODUCT	APPLICATION
CIRCOSOL 2XH. An elasticator of special hydrocarbon structures derived from petroleum.	Manufacture of oil-extended polymers. Plasticizer and softener for butadiene-styrene polymers, natural rubber, and combinations of both.
CIRCO LIGHT. A general-purpose, naphthenic type softener.	Manufacture of nonstaining reclaims and butyl inner tubes. Processing regular neoprene and natural rubber.
SUNDEX 53. A moderately aromatic product compatible with natural rubber, regular neoprene, and butadiene-styrene polymers.	Manufacture of oil-extended polymers. Processing tire tread stocks, rubber footwear, matting, toys, semihard rubbers, etc. Extending high Mooney Neoprene type WHV with a maximum loading of 50 parts per 100 parts neoprene.
SUNDEX 1585. A predominantly aromatic product compatible with natural rubber and butadiene-styrene polymers. NEW	Particularly useful in the manufacture of oil-extended polymers where easy processing and optimum aromaticity are required.
SUNDEX 85. Highly aromatic product compatible with natural rubber, butadiene-styrene polymers, neoprene (regular and WHV), and acrylonitrile polymers. NEW	Manufacture of low cost neoprene articles. Particularly useful for extending neoprene with exceptionally high loadings—75 to 100 parts Sundex-85 to 100 parts neoprene type WHV.
SUNDEX 170. A relatively aromatic product with a high molecular weight.	Manufacture of mastic floor tile, battery cases, and resinous binders.
SUNDEX 41. A complex, dark colored blend of high molecular weight petroleum fractions and a specially prepared asphaltum.	Processing natural rubber and butadiene-styrene polymers.
SUN PROCESS AID 515. A non-staining, highly paraffinic type petroleum derivative with a low viscosity and fair processing ability.	Manufacture of butyl inner tubes. Processing natural rubber and butadiene-styrene polymers where color stability in the finished vulcanizate is important.
SUN PROCESS AID 551. A non-staining, highly paraffinic type product with a low volatility, medium viscosity, and fair processing ability. NEW	Manufacture of oil-extended polymers where non-staining of the finished commercial article is important.
SUN PROCESS AID 594. A medium viscosity, naphthenic type petroleum derivative with a low volatility and good processing ability. NEW	Manufacture of oil-extended polymers. Dry mixing process for natural rubber and butadiene-styrene polymers. Economical where some discoloration in the finished rubber can be tolerated.
For full information on these process aids and on Sun lubricants for rubber-process machinery, call your Sun representative or write to Dept. RW-8.	

Circosol, Circo, Sun, and Sundex are Registered Trademarks

INDUSTRIAL PRODUCTS DEPARTMENT

SUN OIL COMPANY Philadelphia 3, Pa.

IN CANADA: SUN OIL COMPANY LIMITED, TORONTO AND MONTREAL

IN BRITAIN: British Sun Oil Co. Ltd., London W.C.2, England • THE NETHERLANDS: Netherlands Sun Oil Co., Rotterdam C. The Netherlands • WESTERN EUROPE (except the Netherlands), NEAR EAST, NORTH AFRICA: Sun Oil Co. (Belgium) S.A., Antwerp, Belgium.

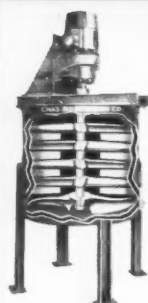


©Sun Oil Company

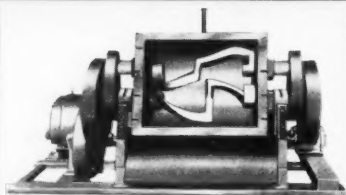


RUBBER PROCESSING MACHINERY

gives better results in less time!

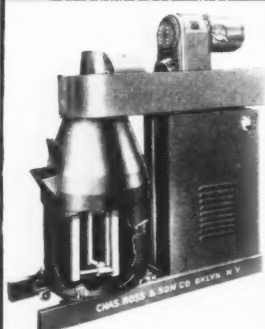
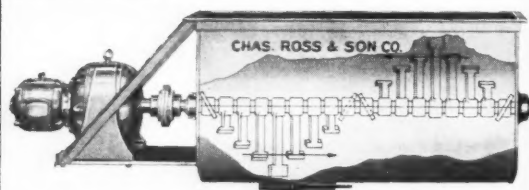


Rubber Cement Mixers
100-1000 Gal. sizes

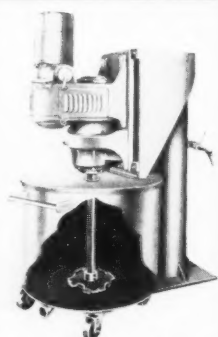


Heavy Duty Double Arm Kneaders
1 pint-150 Gal. sizes

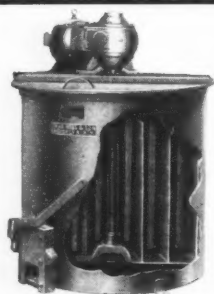
Rubber Reclaiming Mixers
100-1000 Gal. sizes



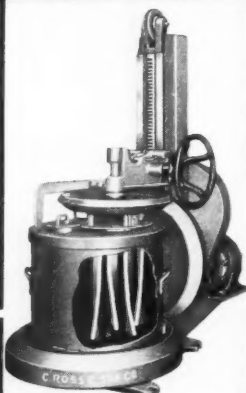
Double Planetary Change Can Mixers
1-150 Gal. sizes



High Speed Change Tank-Mixers
80-250 Gal. sizes



Heavy Duty Paste Mixers
25-1000 Gal. sizes



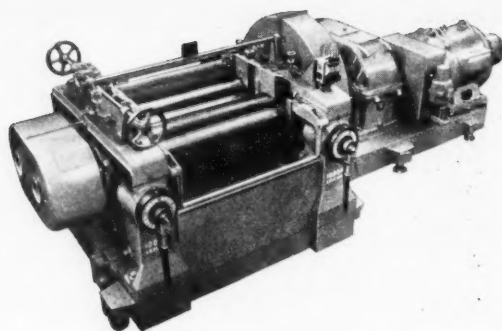
Heavy Duty Change Can Mixers
8-60 Gal. sizes

Almost a century of furnishing Heavy Duty dependable equipment to the rubber industry.

Write for Complete Information!

CHARLES ROSS & SON COMPANY, INC.

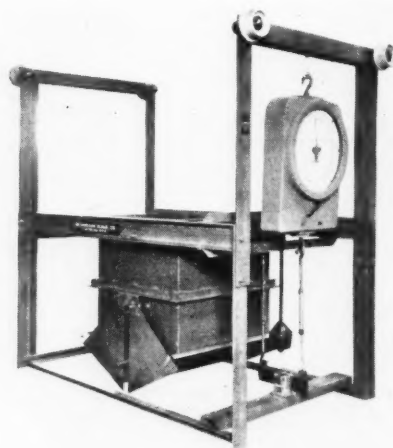
Dept. R. 148-156 Classon Ave., Brooklyn 5, N. Y.



Iddon single geared mixing mill

industry, which is 36 inches from the floor to center line of roll. The height on the Iddon machine is 49 inches from floor level to center line of roll, the standard height of British-made mills.

Where the Lunn safety device must be fitted to an existing installation, a pit is provided in front of the mill operating area in order to adjust the working height of the roll to the height that is required.



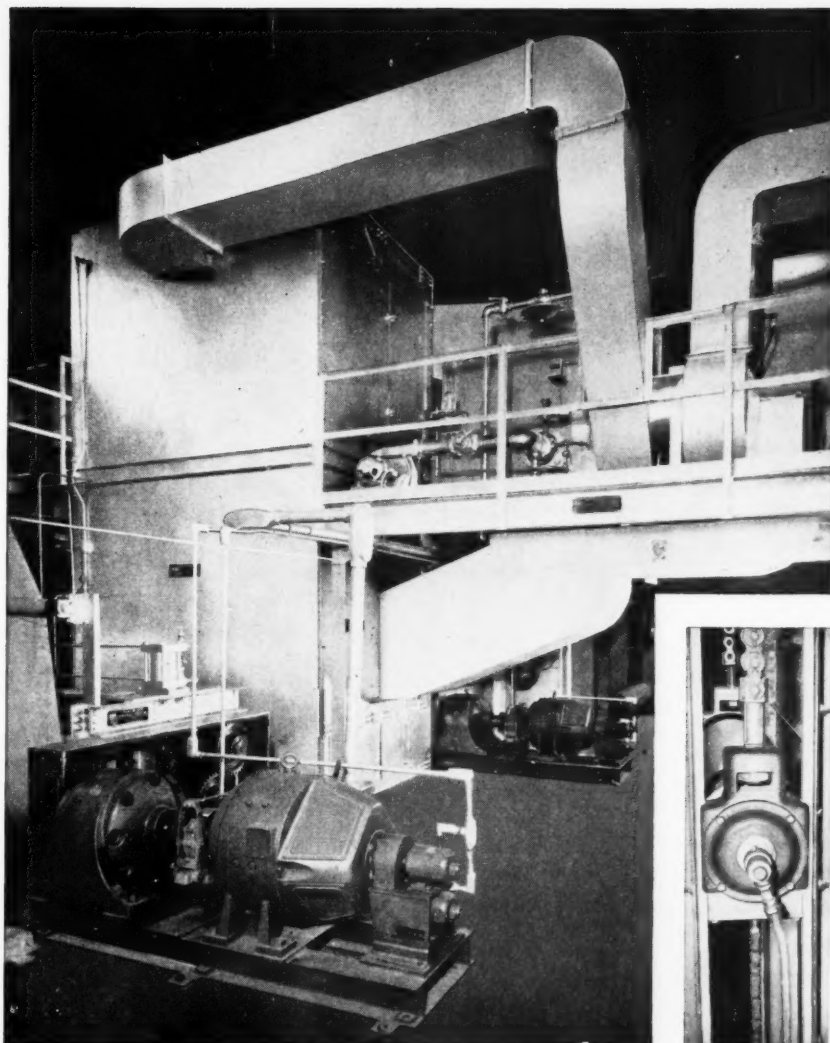
Richardson J-50 Scale

Portable Scale for Bulk Materials

A portable scale designed for weighing heavy bulk materials at storage bins located at scattered points within a plant has been placed on the market by Richardson Scale Co., Clifton, N. J. Designated J-50, the scale is capable of handling loads from 200 to 1,000 pounds. In weight proportioning operations, the scale is wheeled from bin to bin, and desired amounts of material are cumulatively weighed, one batch at a time.

A spring-dial is provided for checking on individual weighings. Accuracy is said to be within 1¼ pounds per 1,000 pound weighings. The new scale may be adapted for mounting on overhead tracks. For liquid weighing operations, the scale is available with a tank weight hopper, which may be pressurized.

"Hose Machines (for Wrapped Hose)," Bulletin 205. Farrel-Birmingham Co., Inc., Ansonia, Conn. 6 pages. Hose machines for the manufacture of wrapped hose are described and illustrated in this folder. Machines for single and multiple operations are shown; capacities of four standard sizes given; and principal design features explained.



◆ Within the first day of startup, full width nylon tire cord processed in this 30-yard-per-minute, 14,000-pound-tension **IOI Rollevator® Oven***, was made into aircraft tires meeting all qualification tests.

◆ The Rollevator® roll automatically moves up and down within the oven, in direct relation to line speeds. Thus, at any line speed, heat-exposure time of the nylon is held constant at a constant temperature setting and at constant tension.

Rollevator® Oven* hot stretches nylon tire cord at constant optimum temperature, constant time and constant tension, at variable line speeds

The IOI Rollevator® Oven* is the answer to more uniform hot stretching of nylon with greater production efficiency. Simple and automatic in operation, it practically eliminates costly shutdown and repair time. When the line is stopped the Rollevator® roll automatically lowers out of the heat zone, eliminating the need for quick cool purging of the oven

and the time and expense involved in reheating the oven when starting up again. Its low operating cost combined with low initial cost assures you of lower production cost. An IOI sales engineer will be glad to give you complete information about the Rollevator® Oven* and to discuss your requirements for any system from 3 to 100 yards per minute.

®Trade Mark Registered
*Pat. Applied For

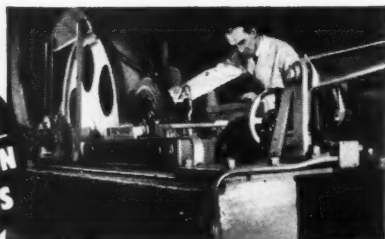
INDUSTRIAL
13813 TRISKETT ROAD



OVENS, INC.
CLEVELAND 11, OHIO

INTERNATIONAL TECHNICAL ASSISTANCE

**HELP
ON YOUR
PRODUCTION
PROBLEMS**



The I.T.A. program is tailored by Dayton Rubber to your needs—for personnel training, for help in establishment of new formulae, for up-dating production techniques on natural rubber, synthetics and foams.

Whatever your problems...processing rayon or nylon cord, fabrics, carbon blacks, etc. . . . I.T.A.'s expert staff of technicians and teachers can help you.

Through I.T.A. you get the latest up-to-the-minute methods you need—at surprisingly low cost. If you wish, Dayton technicians will design your factory or super-vise machinery installations. Write International Technical Assistance Division, Dayton Rubber Company, Dayton 1, Ohio, U.S.A.

Cable Address:
Thorobred



© D. R. 1957

Dayton Rubber

Manufacturer of Tires, Tubes, V-Belts, Rollers, Polyurethane Products and other highly specialized and technical rubber products.

EAGLE-PICHER Lead & Zinc Compounds meet the specific demands of the rubber industry . . .

Eagle-Picher manufactures a comprehensive line of both lead and zinc compounds for the rubber industry. Rigid product control is maintained from the ore to the finished product. More than a century of experience assures you of customer service unequalled in the field.

Zinc Oxides
Basic White Lead Silicate
Basic Carbonate of White Lead
Sublimed White Lead

Litharge
Sublimed Litharge
Red Lead (95% 97% 98%)
Sublimed Blue Lead



THE EAGLE-PICHER COMPANY

Since 1843

General Offices: Cincinnati 1, Ohio

West Coast Sales Agent

THE BUNKER HILL COMPANY, Chemical Products Division
Seattle • Portland • Oakland • San Francisco • Los Angeles • Kellogg, Idaho

NEW MATERIALS

Piccopale Emulsion A-22

An anionic emulsion said to exhibit superior stability in low pH systems has been announced by Pennsylvania Industrial Chemical Corp., Clairton, Pa. Called Piccopale Emulsion A-22, it is suggested for use as a co-binder in systems such as latex paints, clay coatings, textile coatings, and adhesives. It is also recommended as a low-cost binder in molded products, miscellaneous coatings, and other goods. The emulsion is very compatible with such latices as styrene butadiene, neoprene, polyvinyl acetate, and acrylic resin emulsions.

According to the company, the new emulsion provides the following: pigment binding, soil removal at high pigment volumes, resistance to soap, water, acids and alkalis, compatibility with thickeners and protective colloids, retained flexibility, good adhesion, excellent water resistance, packaging and mechanical stability, uniform particle size, reduced formulating costs, and reduced can corrosion.

Some physical properties of Piccopale Emulsion A-22 have been reported as follows:

pH	3.7
pH stability range	2-12
Viscosity range K.U.	45-60
Class of emulsifier	anionic
Softening point of solids (B&R °C.)	70-80

Pliolite Latex 151 for Reinforcing

An aqueous dispersion of a styrene-butadiene copolymer intended chiefly for reinforcing other types of latex is being marketed by the chemical division of The Goodyear Tire & Rubber Co., Akron, O. Designated Pliolite Latex 151, and prepared at high solids by an emulsion polymerization process, it forms films only at elevated temperatures.

It can be used to modify such rubber latices as SBR, nitrile, neoprene, and natural rubber. Its addition produces an increase in hardness, stiffness, and modulus, with the frequent small improvement in tensile strength and tear resistance. The elongation may be reduced slightly at higher levels of modification, while the water resistance of cured compounds containing Pliolite Latex 151 will normally be improved, according to the company.

The latex is used in both curing and non-curing formulations, having little effect on curing and often improving aging characteristics. The stabilization of the latex allows it to be used in latex foam formulations. The necessary quantities for formulation vary from five to 20 parts.

Suggested applications are in fabric coating compounds to increase stiffness and provide a firmer hand, in carpet backing compounds to increase stiffness and improve aging, and in latex foam to increase load bearing capacity, improve processing, and increase tearing strength.

Typical properties of Pliolite Latex 151 have been reported as:

Monomer ratio, styrene/butadiene	85/15
Total solids	51%
Stabilizer	rosin soap
pH	10.3
Average particle size	1000-1500 Å
Specific gravity latex solids	1.04
Latex lbs./gal.	8.55
Solids lbs./gal.	4.44
Viscosity (Brookfield)	62 cps. (@ 50% solids)
Surface tension	42 dynes
Antioxidant	none
Mechanical stability	fair
Acid/salt ion tolerance	low



NOW! IRRIGATION THAT'S TRULY PORTABLE



AND COSTS LESS! THANKS TO ENJAY BUTYL!

Flexible irrigation "pipe" and ditch liners fabricated from Enjay Butyl rubber are helping farmers and growers conserve water by assuring maximum irrigation from available water supplies . . . and at *lower cost*! Combining flexibility with strength and portability, the "pipe" allows irrigation of different areas with the same equipment in a one-man carry operation. Both "pipe" and ditch liners are impervious to weather and highly resistant to soil acids and bacteria. These systems are manufactured by the Carlisle Corp., Carlisle, Pa., and are distributed by Bono Products, Inc., Taft, Texas.

Enjay Butyl may well be able to *cut costs* and *improve the performance* of your product! *Low-in-cost* and immediately available, this truly wonder rubber has been put to profitable use in a wide variety of industrial and consumer products. For further information, and for expert technical assistance, contact the Enjay Company.



Pioneer in Petrochemicals

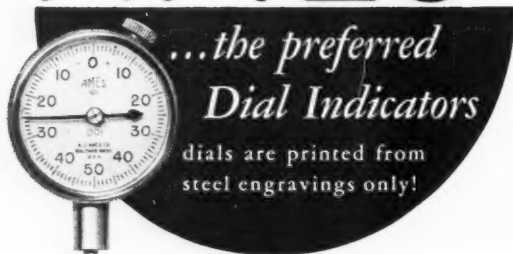
ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.

Akron • Boston • Chicago • Detroit • Los Angeles • New Orleans • Tulsa



Enjay Butyl is the greatest rubber value in the world. It's the super-durable rubber with *outstanding* resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

AMES



To insure the most accurate and legible graduations possible, Ames Dial Indicators are printed with steel engravings exclusively. The use of this costly method is typical of Ames' insistence on maximum precision in every detail. It explains why the lifetime cost of Ames Dial Indicators is lower, and why so many quality control engineers specify Ames as "preferred". Write today for complete information.

Representatives in principal cities



B.C. AMES CO.

59 Ames Street, Waltham 54, Mass.

MANUFACTURERS OF MICROMETER DIAL GAUGES • MICROMETER DIAL INDICATORS

FILLER FLOCK

NATURAL OR SYNTHETIC

WRITE FOR SAMPLES AND QUOTATIONS

CELLUSUEDE PRODUCTS, INC.



500 NORTH MADISON STREET
ROCKFORD, ILLINOIS

Producers of NATURAL OR SYNTHETIC Flock

FINELY PULVERIZED, BRILLIANT

COLORS

FOR RUBBER-VINYLS

Western Representative: **FRED L. BROOKE CO.**,
P. O. Box 463, Oak Park, Ill.

Ohio Representative: **PALMER SUPPLIES CO.**,
2281 Scranton Road, Cleveland 13
800 Broadway, Cincinnati 2

Pacific Coast: **ERWIN GERHARD**,
40 California St., San Francisco 11, Calif.

BROOKLYN COLOR WORKS INC.,
MORGAN & NORMAN AVES., BROOKLYN 22, N.Y.

Nopco Dispersant #2

A low-cost agent for making stable, non-settling, aqueous dispersions of soapstone has been announced by Nopco Chemical Co., Harrison, N. J. Called Dispersant #2, it forms uniform slurries which are expected to find use as anti-blocking agents in the rubber industry, among others. Because of the even exhaustion of the talc, the company says, the dispersion has been found to remain effective for a long time. A light-tan paste, Nopco Dispersant #2 has a moisture content of 70%. Dispersions up to 50% in water have been found stable.

Monsanto Dicyclohexyl Phthalate

Dicyclohexyl phthalate, a plasticizer in nitrocellulose lacquer coatings, is being produced by the organic chemicals division of Monsanto Chemical Co., St. Louis, Mo. A white solid with the narrow melting point range of 64.0-64.6°C., the compound is also used in a variety of resin adhesives and coatings, as a processing aid in rigid polyvinyl chloride, and as a partial replacement of liquid phthalates to reduce oil extraction.

Its major advantages, according to the company, are heat and light stability, resistance to extraction, improved electrical properties, and compatibility with common resins and solvents. DCHP is said to improve tack of adhesives and is used in combination with other plasticizers in polyvinyl chloride, ethyl cellulose, polystyrene, and methacrylate. Exceptionally high quality, especially in purity, color, and odor, is claimed for the material.

Some of its general properties are as follows:

Molecular weight.....	330
Density @ 25° C.....	1.29
Vapor pressure @ 200° C., mm. Hg.....	1.1
Flash point, (Cleveland open cup).....	405° F.
Solubility in water @ 25° C.....	less than 0.01%
Boiling range @ 4 mm. Hg.....	220 to 228° C.
Surface tension, 75 ± 1° C.....	36.4 dynes per cm.

Technical Bulletin No. O-136, describing the material and giving suggestions for compounding, is available from the company's organic chemicals division.

Polaris Red CP 1285

A new type of B-O-N red pigment having a bright, exceptionally blue shade and improved light resistance compared to other non-bleeding azo reds has been announced by the pigment, color, and chemical division of Sherwin-Williams Co., Chicago, Ill. Designated Polaris Red CP 1285, it is a metallic salt of a diazotized aryl amine-sulfonic acid coupled to beta-oxynaphthoic acid, and is said to be a good replacement for Tungstated Rhodamine Y. Polaris Red CP 1285 is recommended for use in rubbers, vinyl plastics, polyethylene, and synthetic fibers because of its good light resistance, especially in tints.

Carbopol 934 in Rubber Cements

The application of Carbopol 934, a synthetic hydrophilic colloid made by B. F. Goodrich Chemical Co., Cleveland, O., for eliminating stickiness, stringiness, and strike-through in rubber cements has been reported. According to the company, Carbopol 934 in a cement composed of acrylonitrile rubber dissolved in ketones formed an exceedingly smooth, easily spread formulation. Less rubber is said to be required for comparable adhesive strength; yet a thick formulation with reduced strike-through is produced which is ordinarily difficult to obtain with low-solids cements owing to their fluidity. Such cements spread easily under the slightest shear and form an instant high-strength gel, Goodrich declares.

Carbopol 934 is a white, free-flowing powder with a bulk density of 13 lbs./cu.ft. A 1% solution in water has a pH of 3.

Service Bulletin GC 20D, entitled "The Use of Carbopol 934 for Thickening Rubber Cements," which describes the preparation of such rubber cements, is available from the company.

us dis-
chemical
uniform
ents in
exhaus-
found
Nopco
up to

acquer
division
d with
pound
ags, as
partial

heat
electrical
vents.
sed in
ethyl
high
ed for

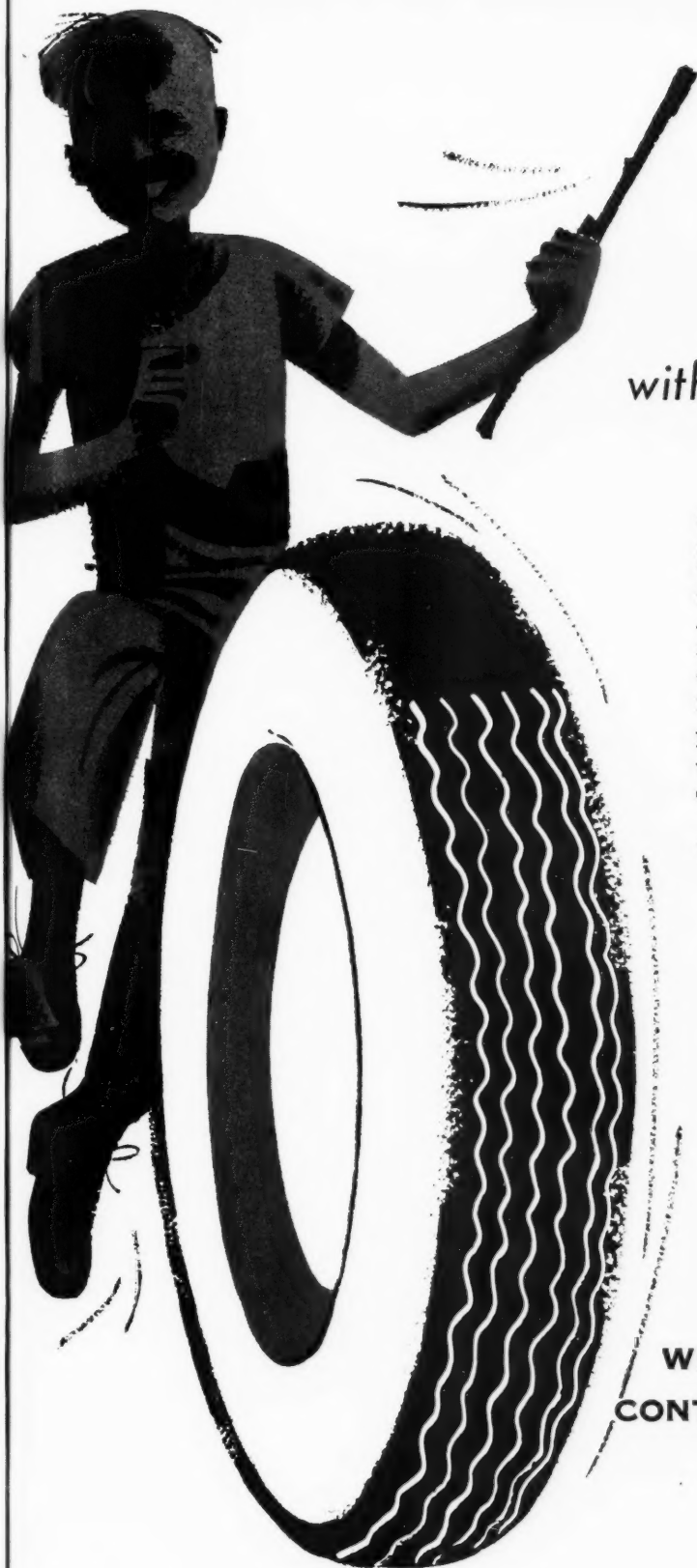
er cm.
al and
m the

ception-
ed to
e pig-
s Co.,
etallie
beta-
nt for
ended
thetic

c col-
0., for
rubber
bopol
ed in
mula-
hesive
gh is
solids
under
gel,

k den-
3.
ol 934
epara-
ny.

ORLD



ROLLING ALONG

with the rubber industry

Over the years, Witco-Continental has grown steadily with the rubber industry. This planned expansion of our plant facilities...research and technical laboratories...places us in an excellent position to meet every rubber black need and to assist our customers with their carbon black problems.

For prompt, integrated service, phone or write your nearest Witco-Continental office.

Witco-Continental **CARBON BLACKS**

FURNACE BLACKS

Continex® SRF—Semi-Reinforcing
Continex SRF-NS—Non-Staining
Continex HMF—High Modulus
Continex HAF—High Abrasion
Continex FEF—Fast Extruding
Continex ISAF—Intermediate Super Abrasion
Continex CF—Conductive Furnace

CHANNEL BLACKS

Continental® AA—(EPC)—Witco No. 12
Continental A—(MPC)—Witco No. 1
Continental F—(HPC)—Witco No. 6
Continental R-40—(CC)—Conducting



37 Years of Growth

WITCO CHEMICAL COMPANY
CONTINENTAL CARBON COMPANY

122 East 42nd Street, New York 17, N. Y.

Chicago • Boston • Akron • Atlanta • Houston • Los Angeles
San Francisco • London and Manchester, England

NEW PRODUCTS

Goodyear Terrazzo Rubber Flooring

A new, low-cost terrazzo-style rubber flooring is being marketed by the Goodyear Tire & Rubber Co., Akron, O. Available in both tile and roll goods form, the flooring is being offered in residential (0.080) and $\frac{1}{8}$ -inch gage in about 12 pattern styles in various color combinations. Homogeneous in construction, the new product has a design effect obtained by integration of individual color chips into the basic background hues.

Firestone Open-Center Spade-Grip Tire

A new open-center tractor tire that is said to allow rice and cane farmers to start combining operations before irrigated fields have been dried by the sun is being offered by Firestone Tire & Rubber Co., Akron, O. Called Open-Center Spade-Grip, the rayon cord tire has a tread twice as deep as that of conventional open-center tires, heavy shoulders, and a wide cross-section that provides maximum flotation over sandy-loam fields. Available in the standard 18-26 size, the tire is said to allow continuous in-operation cleaning.

Fisk "Permanent Balance" Passenger Tire



Fisk Safti-Flight.

What is called the first passenger tire with permanent balance has been introduced by the Fisk tires division of United States Rubber Co., New York, N. Y. Called Safti-Flight, the tire is said to achieve a vibrationless ride even at high speed, as well as easier steering, longer tread wear, and a quieter ride.

The tubeless tire is balanced by a thin, wide strip of very dense rubber that runs around the inside of the tire. The strip, or balance band, is vulcanized permanently to the lining of the tire when the tire is cured. It is regarded as a basic advance in the design of

tubeless tires, where there is no inner tube to help hold the "dough" against the inside of the tire.

Made with nylon tire cord alleged to be twice as strong as the nylon cord normally used in tires, the new Fisk tire is said to be the only passenger tire in the world with an eight-ply rating and is considered virtually blowout-proof. The balance band also gives extra grip around an object in case of puncture, thereby helping to prevent air loss, according to the company.

The Safti-Flight also features a new tread design which has 92% of the footprint area of the tire in contact with the road, compared with 75-80% in the ordinary tire. The five-row tread has a central rib to provide steering and handling ease, flanked by two wide rows to give skid control and traction. A $\frac{3}{4}$ -inch-wide white sidewall is protected by a double scuff guard.

TECHNICAL BOOKS

BOOK REVIEWS

"Annual Report on the Progress of Rubber Technology."

Vol. XX, 1956. Edited by T. J. Drakeley. Published by W. Heffer & Sons, Ltd., Cambridge, England, for the Institution of the Rubber Industry, London, England. Cloth cover, $7\frac{1}{4}$ by 9 $\frac{3}{4}$ inches. 161 pages. Price £1-5s.

This annual report of the IRI, as emphasized in the foreword by C. Falconer Flint, chairman of the annual report subcommittee, is exactly as defined by the title and is not a complete bibliography and should not be used as such. It is prepared to show the pattern of progress in rubber technology by use of selected items from the literature and is therefore sometimes critical.

The various chapters are prepared by leading authorities in their fields and include a historical and statistical review; planting and production of raw rubber and latex; properties, applications, and utilization of latex; chemistry of raw and vulcanized rubber; physics of raw and vulcanized rubber, synthetic rubber, testing and equipment and specifications; and compounding ingredients. Also covered are fibers and fabrics; tires; belting; hose and tubing; cable and electrical insulation; mechanical rubber goods; cellular rubber; flooring; works processes and materials; roads; etc.

Dr. Flint in his comments on latex applications makes the point that the period under review "does not appear to glow with discovery in the field of latex science and technology . . ." but that those interested should keep in touch with developments in the field of "polymer modified" natural rubber latices and their synthetic counterparts.

W. J. S. Naunton in discussing synthetic rubber emphasizes that no great advances such as synthetic *cis*, 1,4 polyisoprene were made in 1956, but rather the period was one of taking stock of the present position, both technical and commercial.

Observations made of the progress in the fields of belting, footwear, mechanical rubber goods, and cellular rubber are worth particular attention.

Although not to be considered a bibliography, the literature references are extensive, but selective, and a name and a subject index are provided.

"A Guide to the Literature of Chemistry." Second Edition. By E. J. Crane, Austin M. Patterson, and Eleanor B. Marr. John Wiley & Sons, Inc., New York. Cloth cover, 6 by 9 inches, 408 pages. Price \$9.50.

No chemist can possibly know all of chemistry, but he can know how and where to look for chemical information. The second edition of the Guide provides an effective key to the vast chemical literature of today.

The first edition of this book by E. J. Crane, director and editor of the Chemical Abstracts Service of the American Chemical Society, and the late Austin M. Patterson, former professor of chemistry at Antioch College, was published in 1927. The second edition is primarily the work of Eleanor B. Marr, assistant professor of chemistry at Hunter College, New York. As Dr. Crane states in the foreword, while Dr. Marr is now the principal author, the authors of the first edition, with appreciation of her work, have contributed enough from their wide experience with chemical literature to make this edition in a restricted sense a three-author product.

In essence this edition of the Guide (1) contains the most frequently used information, (2) gives sources where additional information can be found, (3) gives sources of less frequently used information, and (4) points out methods whereby one can keep up to date on literature and methods of using it.

Actually, the first chapter discusses the problem and objectives,

S

ology."

Heffer
of the
by 934

reword
bcom-
mplete
red to
use of
etimes

ties in
plant-
pplica-
anized
ubber,
ng in-
; hose
ubber
erials;

es the
glow
."
velop-
actices

s that
were
ck of

elting,
r are

ature
sub-

ition.
John
, 408

e can
The
e vast

and
erican
ormer
1927.
Marr,
York.
w the
iation
ience
sense

most
ional
ently
e can

tives,

ORLD

BLE 2
anti-o
speed
pound
carbo
as it is
its h
and f
have
anti-c

H
TR
ONE

BLE 25

ANTI- OXIDANT

resists . . .

- ⚡ FLEX CRACKING
- ⚡ HEAT
- ⚡ OXIDATION

BLE 25 is a superlative anti-oxidant for tyres, high speed mechanicals, compounds heavily loaded with carbon black or other fillers, as it is a flux of the best type. Its heat-ageing qualities and flex-cracking resistance have no equal among anti-oxidants.

THE RUBBER REGENERATING CO. LTD.
TRAFFORD PARK · MANCHESTER 17 · ENGLAND

ONE: Trafford Park 1424/8 (5 lines). 'GRAMS: "Regenerate". CODE: Western Union Telegraph, Universal Edition

the second covers books, the third periodicals, the fourth patents, the fifth government publications, the sixth trade literature, and the seventh other sources. Chapter eight deals with indices, nine with libraries, and ten with procedure in literature searches.

Extensive appendices cover such things as symbols, abbreviations, and standards used in chemical literature; a bibliography list of periodicals; scientific and technical organizations; and dealers and publishers.

An important point made in the first chapter probably sums up effectively the real value of this book when it is stated that although the spirit of laboratory research ought never be discouraged, there is need of more great minds to be devoted to the correlation, interpretation, and application of recorded facts.

"The production of chemical literature has run ahead of use; we fall far short of full assimilation and interpretation of available records."

NEW PUBLICATIONS

"Protox Zinc Oxides in Rubber." The New Jersey Zinc Co., New York 38, N. Y. 23 pages. Protox zinc oxides are surface treated with propionic acid to improve the ease of incorporation and dispersion of zinc oxide in rubber. They are available both in pelleted and non-pelleted forms.

Handling and storage and processing characteristics with special reference to power consumption during mixing, compound shrinkage characteristics, and reinforcing characteristics of these zinc oxides are discussed in some detail. Included also is information on the use of Protox zinc oxides in latex compounding. Physical property data is presented in tables and graphs and illustrations of dispersion, extrusion and calendaring properties are also found in this booklet.

"Enjay Butyl for Tires." Enjay Co., Inc., New York, N. Y. 54 pages, loose-leaf, hard cover. The purpose of this publication is to present an objective and up-to-date account of the utilization of butyl rubber for tires and it has accomplished its purpose very well. In addition, it has added to the literature on tire compounding and more particularly fabrication, on which latter there is limited information.

Passenger car tire compounding, fabrication and performance are covered in the first two sections, which comprise the major part of the publication. Logging, construction, mining truck, and farm tractor tires are covered in the next two sections. An appendix gives useful information on nomenclature, compounding ingredients, test specifications and procedures, cure evaluation, and thermal diffusivity and conductivity.

"B. F. Goodrich Industrial Tires and Wheels." B. F. Goodrich Tire Co., Akron, O. 36 pages. Specifications of the firm's many types of industrial tires are included in this illustrated catalog. Written for maintenance superintendents, industrial engineers, and purchasing agents, the book also contains sundry information on industrial tires, such as use of each of the types, variations in pneumatic tire capacities at various speeds, and wheel and caster combinations available.

"The Industrial Chemistry, Properties, and Application of Silicones." By Charles E. Reed. American Society for Testing Materials, Philadelphia, Pa. 52 pages. Price, \$1.50. This is the thirtieth Edgar Marburg Lecture originally presented at the fifty-ninth annual meeting of the ASTM. Mr. Reed, general manager of General Electric's silicone products department, discusses the molecular structures of the silicones, their properties, commercial manufacture, and applications and indicates the trends in future developments of silicone rubbers, resins, and other products.

"Readco Equipment." Bulletin No. 1483. Read Standard Division, Capitol Products Corp., York, Pa. 8 pages. The company's double-arm, spiral-ribbon, and vertical mixers suitable for laboratory, pilot plants, and commercial production are described in this illustrated catalog.

Publications of The Goodyear Tire & Rubber Co., Chemical division, Akron, Ohio:

"New Look at Nitrile Rubber . . . Chemigum." 36 pages. The properties, applications and processing of the company's Chemigum nitrile rubbers are discussed in this extensively illustrated brochure in color. Particularly are the nitrile rubbers compared with the other synthetic rubbers and with the natural product, and their specific advantages stressed.

"Recommendations for Meeting Spec. MIL-G-1086-B." Tech-Book Facts Formulations Bulletin 56-321 (replaces 56-80). 2 pages. Appearing here is a Chemigum recipe for synthetic rubber gaskets used on bolted steel or aluminum tanks for storage of gasoline, oil, water, or asphalt, together with test data.

"Properties of Pliolite Latex 151." Tech-Book Facts Bulletin 57-129. 1 page. Properties, compounding, and applications of Pliolite Latex 151, a styrene/butadiene latex whose principal application is the modification of rubber latices, are included in this bulletin.

"Diamond Precipitated Calcium Carbonates for Polyvinyl Chloride Applications." Diamond Alkali Co., Cleveland, O. 16 pages. This booklet reviews the use of eight of the company's precipitated calcium carbonates as inert fillers for compounding of polyvinyl chloride products. Basic stock formulations are given, together with 54 graphs or charts covering tensile, modulus, and hardness factors of unfilled and filled stocks.

Publications of the British Rubber Producers' Research Association, Welwyn Garden City, Herts., England:

No. 249. **"Aspects of Physical Basis of Reinforcement."** L. Mullins. 11 pages. Recent developments in rational ideas of what reinforcement means physically are described. Probably the most important characteristic of rubber vulcanizates with good tear and abrasion resistance is their ability to form strong, hard, tear resistant structures at the tips of growing tears. The author discusses the significance of this conclusion in relation to the assessment of the quality of rubber vulcanizates.

No. 251. **"Helical Spring Stress Relaxometer."** J. P. Berry. 7 pages. Detailed descriptions of a stress-relaxometer and an intermittent stress relaxometer are given in this paper. Sufficient information is conveyed to facilitate their fabrication and use.

No. 253. **"The Adsorption of Serum Albumin and Sodium Dodecyl Sulfate at Emulsion Interfaces."** E. G. Cockbain. 10 pages. The distribution of serum albumin and sodium dodecyl sulfate between the interface and aqueous phase of *n*-decane emulsions was measured, and the total interfacial area of the emulsions determined.

Non-Free Sulfur Curing Systems

(Continued from page 686)

Bibliography

- (1) T. Alfrey, J. G. Hendricks, R. M. Hershey, H. Mark, India RUBBER WORLD, 112, 577 (1945); 113, 653 (1946).
- (2) D. J. Metz, R. B. Mesrobian, J. Polymer Sci., 11, 83 (1953).
- (3) A. L. Pedersen. "Aging Properties of Low Sulfur Rubber Vulcanizates," a communication from Northern Cable & Wire Works, Ltd., Copenhagen, Denmark (1954).
- (4) M. Braden, W. P. Fletcher, G. P. McSweeney, Trans. Inst. Rubber Ind., 30, 44 (1954).
- (5) M. Braden, W. P. Fletcher, Ibid., 31, 155 (1955).
- (6) RUBBER WORLD, 135, 867 (1957); 136, 65 (1957).
- (7) Anal. Chem., 23, 1646 (1951).
- (8) Private communication from Semet-Solvay Petrochemical Division, Allied Chemical & Dye Corp., New York, N. Y.
- (9) I. I. Ostromislenski, J. Russ. Phys.-Chem. Soc., 47, 1467, 1885 (1915).
- (10) New Product Data Sheet No. 4-5-55. Hercules Powder Co., Wilmington, Del.
- (11) C. H. Lufter, RUBBER WORLD, 133, 511 (1956).
- (12) New Product Data Sheet No. 5-2-55. Hercules Powder Co.
- (13) Rubber Chem. Tech., 27, 883 (1954).

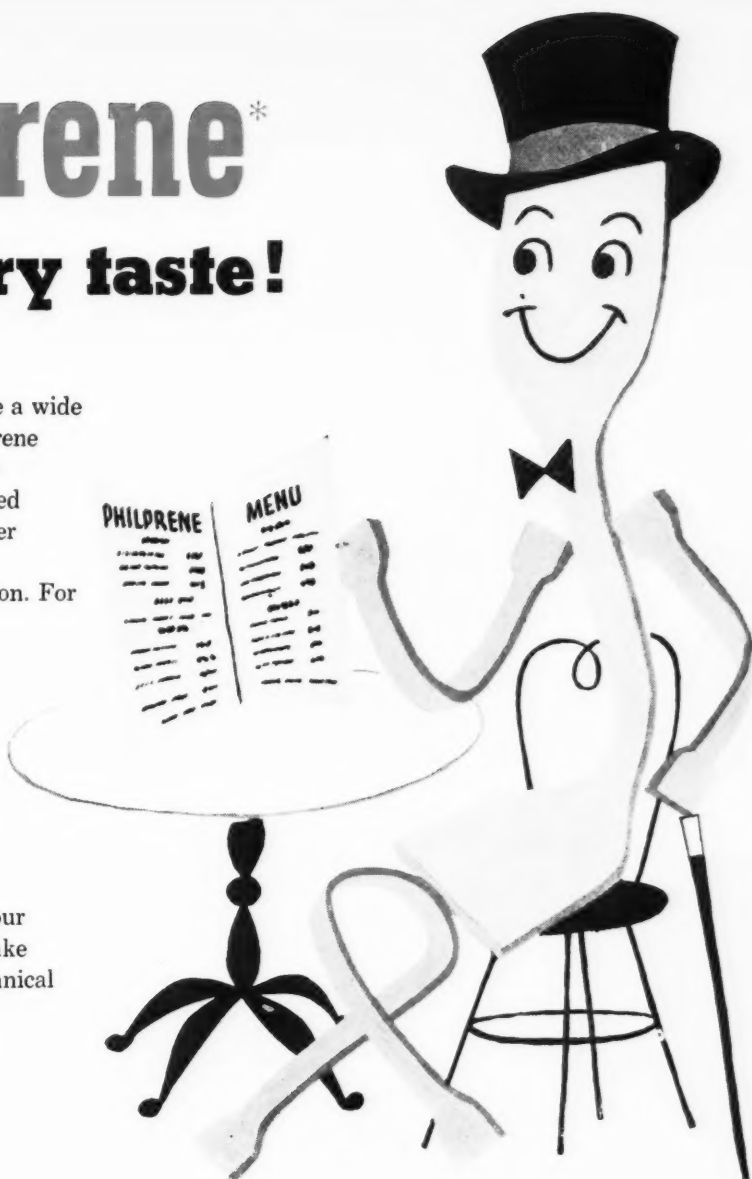
Philprene*

suits every taste!

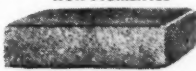

Order what you like! You have a wide choice. Twenty different Philprene rubbers allow you to select the physical characteristics you need in your product. And the proper Philprene can also be of help throughout your entire operation. For example, Philprene can help speed up mixing . . . ease extrusions . . . control die swell and shrinkage.

To find out which Philprene you should be using, refer to our new Philprene catalog or consult your Phillips Technical Representative. He will be glad to help with your individual rubber problems. Take advantage of this valuable technical assistance and Phillips long experience in the rubber field.

*A trademark



CURRENT PHILPRENE POLYMERS

	NON-PIGMENTED 	PIGMENTED WITH PHILBLACK* 
HOT	PHILPRENE 1000 PHILPRENE 1009 PHILPRENE 1001 PHILPRENE 1010 PHILPRENE 1006 PHILPRENE 1018 PHILPRENE 1019	PHILPRENE 1100 (Pigmented with EPC Black) PHILPRENE 1104
COLD	PHILPRENE 1500 PHILPRENE 1502 PHILPRENE 1503	PHILPRENE 1600 PHILPRENE 1601 PHILPRENE 1605
COLD OIL	PHILPRENE 1703 PHILPRENE 1706 PHILPRENE 1708 PHILPRENE 1712	PHILPRENE 1803



PHILLIPS CHEMICAL COMPANY

Rubber Chemicals Division
318 Water Street, Akron 8, Ohio

District Offices:
Chicago, Providence and Trenton
Warehouses:
Akron, Boston, Chicago, Trenton

MARKET REVIEWS

Natural Rubber

The natural rubber market during the June 16-July 15 period continued on its quiet, featureless way. Spot prices in New York remained remarkably steady, again registering less than a 1¢-a-pound high-low price differential. Only 17,300 tons of rubber were traded on the New York Commodity Exchange.

Strictly within trade considerations, the narrow price fluctuation is a result of continued, though restrained, factory buying which has offered little scope for speculative manipulation. Lower prices could have resulted from what were called substantial offerings from the Far East, but these did not materialize because of the sustained in-take. Trade sources assume that these purchases have gone partly to factories, partly to dealers against short positions, but undoubtedly some portion has been taken in by dealers who have sold previously to consumers against hedge purchases. This last procedure implies the resale of hedges.

Apart from sudden breaks in the international political situation, the market steadiness is expected to continue for some time. The International Rubber Study Group, meeting in Jogjakarta in early July, indicated that 1957 world consumption of natural rubber would be about 1,910,000 tons, exceeding an estimated world production figure of 1,875,000 tons by 35,000 tons. This deficit, or excess of demand over supply, is seen to be acting as a bolster for what would otherwise be a falling market.

Statistically, on the New York Commodity Exchange, June sales amounted to 20,930 tons, none on the Rubber-Standard Contract. There were 20 trading days during June; 19 during the June 16-July 15 period.

Week-end closing Commodity Exchange future prices for the Rex Contract were as follows:

REX CONTRACT						
	May	June	June	July	July	
	24	21	28	5	12	
May	31.55					
July	31.38	32.90	32.64	32.70	32.85	
Sept.	31.27	32.40	32.25	32.20	32.60	
Nov.	31.08	32.20	32.09	31.90	32.40	
1958						
Jan.	30.93	32.00	31.89	31.70	32.25	
Mar.	30.70	31.80	31.69	31.60	32.15	
May	30.50	31.60	31.45	31.45	32.00	
July		31.40	31.09	31.30	31.60	
Total weekly sales, tons	2,250	3,740	5,210	2,070	4,730	

On the physical market, RSS #1, according to the New York Rubber Trade Association, averaged 32.84¢ a pound for

the June 16-July 15 period. The remarkable steadiness of the grade is indicated by its 32.84¢ average for the first half of July and its 32.78¢ average for the month of June. Other average June spot prices for representative grades were: RSS #3, 32.00¢; #3 Amber Blankets, 29.43¢; and Flat Bark, 21.89¢ a pound.

NEW YORK PHYSICAL MARKET
WEEK-END CLOSING PRICES

	May	June	June	July	July
	24	21	28	5	12
RSS: #1	32.00	33.00	33.00	32.63	32.75
2	31.50	32.75	32.50	32.25	32.50
3	31.00	32.50	32.25	32.00	32.25
Pale Crepe					
=1 Thick	36.00	36.63	36.38	35.88	37.13
Thin	35.00	35.63	35.38	34.88	34.88
=3 Amber Blankets	28.00	29.50	29.88	29.13	29.25
Thin Brown Crepe	27.75	29.13	29.25	28.63	28.75
Standard Flat Bark	21.38	21.88	21.63	21.50	21.63

Synthetic Rubber

Consumption and production of synthetic rubbers were both lower during June, according to the monthly report of The Rubber Manufacturers Association, Inc. Consumption of synthetic rubbers in June amounted to 70,772 long tons, compared with the 79,930 long tons consumed in May. Consumption, according to types, in June compared to May was as follows: SBR, 58,728 tons against 66,515; neoprene, 5,742, against 6,474; butyl, 4,186, against 4,915; and nitrile, 2,116, against 2,026.

Production, according to types, in June compared with May in long tons was as follows: SBR, 67,809, against 77,124; neoprene, 9,678, against 9,234; butyl, 4,379, against 6,094; and nitrile, 2,600, against 2,560. Exports of synthetic rubber rose from 15,790 to 17,125 long tons, with the major factor in this increase being the shipments for export reported by SBR producers of 13,400 long tons in June, against 12,400 long tons in May.

A significant contributing factor to the decline in synthetic rubber consumption was the closing of United States Rubber Co.'s Detroit plant by a strike, but a general decline in consumption during June throughout the industry was also evident. Production of SBR was influenced also by a strike at the Port Neches, Tex., plant of U. S. Rubber which was still going on in late July.

With the usual vacation shutdown periods in July and the loss of SBR production at Port Neches, consumption and production will probably not show much upturn until August or September at the earliest. Total synthetic rubber consump-

tion for the first six months of 1957 at 471,457 long tons, however, is well ahead of the 448,502 long tons consumed during the first half of 1956. Only 458,543 long tons will have to be consumed during the last half of 1957 to equal the estimated consumption of 930,000 long tons for the year, but there are many indications that the last quarter of 1957 will see some new consumption records, and more than 930,000 tons will be consumed.

Latex

Trading in natural rubber latices was slightly improved during the June 16-July 15 period. Observers said that although the offtake was modest, it kept pace with the current supply position. Synthetic latices were also more in demand than during the previous period. The more optimistic situation was said to have resulted from the somewhat faster rate of automotive sales in this country during May and early June.

Prices for ASTM Centrifuged Concentrated natural latex, in tank-car quantities, f.o.b. rail tank cars, ranged during the period from 40 to 43¢ per pound solids. Prices of synthetic latices were steady at 22 to 32¢ for SBR; 37 to 47¢ for neoprene; and 44 to 54¢ a pound for nitrile-types.

Final April and preliminary May domestic statistics for all latices were reported by the United States Department of Commerce as follows:

(All Figures in Long Tons, Dry Weight)

Type of Latex	Pro-duc-tion	Im-ports	Con-sump-tion	Month-End Stocks
Natural				
Apr.	0	8,812	6,434	12,064
May	0		5,818	11,730
SBR				
Apr.	6,306	42	5,554	8,096
May	5,495		4,952	8,197
Neoprene				
Apr.	976	0	772	1,183
May	1,081	0	813	1,262
Nitrile				
Apr.	881	0	710	1,836
May	932	0	582	1,273

Scrap Rubber

Very little activity was in evidence in the scrap rubber market during the June 16-July 15 period. Many reclaimers and consumers of scrap rubber were closed for their annual vacations and inventory taking. Naugatuck, which resumed operations on July 8, is scheduled for another two-week shutdown beginning August 2. In spite of the lack of activity, scrap rubber prices continued unchanged.

	Eastern Points	Akron, O.
	(Per Net Ton)	
Mixed auto tires	\$10.00/13.00	\$13.00
S.A.G. auto tires	Nom.	Nom.
Truck tires	Nom.	Nom.
Peelings, No. 1	37.00	37.00
2	Nom.	Nom.
3	16.00	17.00
Tire buffing	Nom.	Nom.
	(¢ per Lb.)	
Auto tubes mixed	2.75	2.75
Black	6.50	6.50
Butyl	3.75	3.75
Red	7.00	7.00

957 at
ahead
during
3 long
ing the
imated
for the
ns that
ne new
n 930,-

es was
16-July
though
ce with
nthetic
d than
more
ave re-
rate of
during

Concen-
ntities,
ng the
solids.
ady at
or neo-
nitrile-

ay do-
ere re-
artment

Weight)

Month-
End
Stocks

12,064
11,730

8,096
8,197

1,183
1,262

1,836
1,273

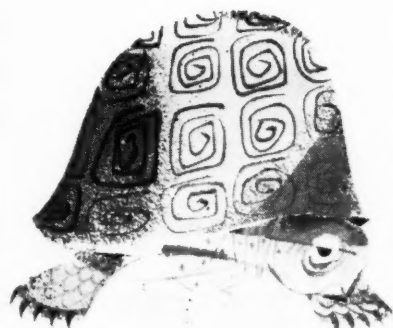
nce in
e June
rs and
sed for
y tak-
rations
r two-
2. In
rubber

Akron,
O.
(on)

\$13.00
Nom.
Nom.
37.00
Nom.
17.00
Nom.

b.)
2.75
6.50
3.75
7.00

ORLD



SLOW
action at
processing
temperatures



FAST
action
at cure
temperatures



RELIABLE
cure properties
and
physical results

NOBS *

Delayed-Action ACCELERATORS

Slow at processing temperatures—*fast* at curing temperatures. These characteristics of NOBS accelerators bring to mind the tortoise and the hare. NOBS embodies a subtle change from tortoise to hare at curing temperatures. Adding *reliable* cure properties and physical results, we have outstanding delayed-action accelerators.

Thorough evaluation of NOBS No. 1 and NOBS SPECIAL, alone and in conjunction with activators, has been made by Cyanamid's Rubber Chemicals Department. The resulting data should help considerably in setting up your rubber formulations for optimum processing safety, cure cycles and cure properties.

Your Cyanamid Rubber Chemicals representative can supply full information.

*Trademark



CYANAMID

AMERICAN CYANAMID COMPANY
RUBBER CHEMICALS DEPARTMENT
Bound Brook, New Jersey

SALES REPRESENTATIVES AND WAREHOUSE STOCKS: Akron Chemical Company, Akron, Ohio • H. M. Royal, Inc., Trenton, N. J. • H. M. Royal, Inc., Los Angeles, Calif. • Ernest Jacoby & Company, Inc., Boston, Mass. • Herron & Meyer of Chicago, Chicago, Ill. • In Canada: St. Lawrence Chemical Company, Ltd., Montreal and Toronto

Reclaimed Rubber

Little activity in the reclaimed rubber market was evident during the June 16-July 15 period as summer vacations and shutdowns took their expected toll. Trade observers look forward to better business conditions in August.

Reclaimed rubber prices were unchanged.

RECLAIMED RUBBER PRICES

Whole tire; first line	\$.11
Fourth line	.0975
Inner tube; black	.16
Red	.21
Butyl	.14
Pure gum, light colored	.23
Mechanical, light colored	.135

The above list includes those items or classes only that determine the price basis of all derivative reclaim grades. Every manufacturer produces a variety of special reclaims in each general group separately featuring characteristic properties of quality, workability, and gravity at special prices.

Industrial Fabrics

Negligible quantities of wide cotton fabrics for coating purposes were bought during the June 16-July 15 period. Some trading of cotton ducks was reported to have taken place. Fair to sizable lots of Army ducks and enameling ducks exchanged hands. Total activity, however, was very poor during the period, a traditional situation in high-summer.

Period-end prices of cotton fabrics were unchanged.

INDUSTRIAL FABRICS

Drills	
59-inch 1.85 yd.	yd. \$0.345
2.25-yd.	.295
Ducks	
38-inch 1.78-yd. S.F.	yd. nom.
2.00-yd. D.F.	.30
51.5-inch, 1.35-yd. S.F.	.4675
Hose and belting	.69
Osnaburgs	
40-inch 2.11-yd.	yd. .24
3.65-yd.	.1575
Raincoat Fabrics	
Printcloth, 38½-in., 64-60, 5.35-yd.	yd. .135
6.25-yd.	.1175
Sheeting, 48-inch, 4.17-yd.	.20
52-inch, 3.85-yd.	.23
Chafers Fabrics	
14.40-oz./sq. yd. Pl.	yd. .73
11.65-oz./sq. yd. S.	.61
10.80-oz./sq. yd. S.	.6575
8.9-oz./sq. yd. S.	.67
Other Fabrics	
Headlining, 59-in., 1.65-yd., 2-ply	yd. .41
64-inch, 1.25-yd., 2-ply	.59
Sateens, 53-inch, 1.32-yd.	.535
58-inch, 1.21-yd.	.57

Rayon

Total packaged production of rayon and acetate filament yarn during June was 56,700,000 pounds, consisting of 26,600,000 pounds of high-tenacity rayon yarn and 30,100,000 of regular-tenacity yarn.

May production had been: total, 62,200,000 pounds; regular-tenacity yarn, 29,600,000 pounds; and high-tenacity rayon yarn, 32,600,000 pounds.

Total filament yarn shipments to domestic consumers came to 53,000,000 pounds, of which 24,300,000 pounds were high-tenacity rayon yarn, and 28,700 pounds were regular-tenacity yarn. May shipments had been: total, 58,200,000 pounds; high-tenacity, 28,800,000 pounds; regular-tenacity, 29,400,000 pounds.

Total end-of-June stocks were 69,400,000 pounds, made up of 13,100,000 pounds of high-tenacity rayon yarn and 56,300,000 pounds of regular-tenacity rayon yarn. End-of-May stocks had been: total, 67,000,000 pounds; high-tenacity yarn, 11,500,000 pounds; regular-tenacity, 55,500,000 pounds.

Prices of rayon tire yarns and fabrics in mid-July were unchanged from those of

the previous month.

RAYON PRICES

Tire Yarns

High-Tenacity	
1100/480	\$0.59/\$0.64
1100/490	.59/ .64
1150/490	.64
1165/480	.65
1230/490	.64
1650/720	.55/ .61
1650/980	.55/ .61
1875/980	.61
2200/960	.55/ .60
2200/980	.55/ .60
2200/1466	.64
4400/2934	.60

Super-High-Tenacity

1650/720	.58
1900/720	.58

Tire Fabrics

1100/490/2	.77
1650/980/2	.725
2200/980/2	.715

CALENDAR of COMING EVENTS

September 7	October 10
Connecticut Rubber Group. Grassy Hill Park, Shelton, Conn.	Northern California Rubber Group.
September 11-13	October 11
Division of Rubber Chemistry, ACS. Hotel Commodore, New York, N. Y.	Chicago Rubber Group. Furniture Club, Chicago, Ill.
September 12	October 17
Northern California Rubber Group.	Cleveland-Akron Section, Society of Plastics Engineers. Regional Technical Conference on Polyethylene. Hotel Carter, Cleveland, O.
September 18-20	October 18
National Bureau of Standards, Catholic University of America, Applied Physics Laboratory of Johns Hopkins University. Symposium—"Formation and Stabilization of Free Radicals." National Bureau of Standards, Washington, D. C.	Boston Rubber Group. Hotel Somerset, Boston, Mass.
September 23-25	October 24
American Society of Mechanical Engineers. Fall Meeting. Hotel Statler, Hartford, Conn.	Southern Ohio Rubber Group.
September 26	October 25
Fort Wayne Rubber & Plastics Group. Van Orman Hotel, Fort Wayne, Ind.	Akron Rubber Group. Sheraton-Mayflower, Akron, O.
September 27	October 26
Ontario Rubber Group. Field Day. Dundas Golf & Country Club, Dundas, Ont., Canada.	Philadelphia Rubber Group. Poor Richard Club, Philadelphia, Pa.
September 30-October 5	November 5
ISO/TC 45. Seventh Meeting. Zurich, Switzerland.	The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.
October 1	November 7
The Los Angeles Rubber Group, Inc. Biltmore Hotel, Los Angeles, Calif.	Rhode Island Rubber Club.
October 4	November 14
New York Rubber Group. Henry Hudson Hotel, New York, N. Y.	Northern California Rubber Group.
October 8	November 15
Buffalo Rubber Group.	Chicago Rubber Group.
	Connecticut Rubber Group.
	November 15-16
	Southern Rubber Group. Peabody Hotel, Memphis, Tenn.
	December 1-6
	American Society of Mechanical Engineers. Annual Meeting. Hotel Statler, New York, N. Y.

99/\$0.64
 99/.64
 .64
 .65
 .64
 .61
 .61
 .61
 .60
 .60
 .60
 .64
 .60

.58
 .58

.77
 .725
 .715

b.

of
 al
 r-

it,

y-

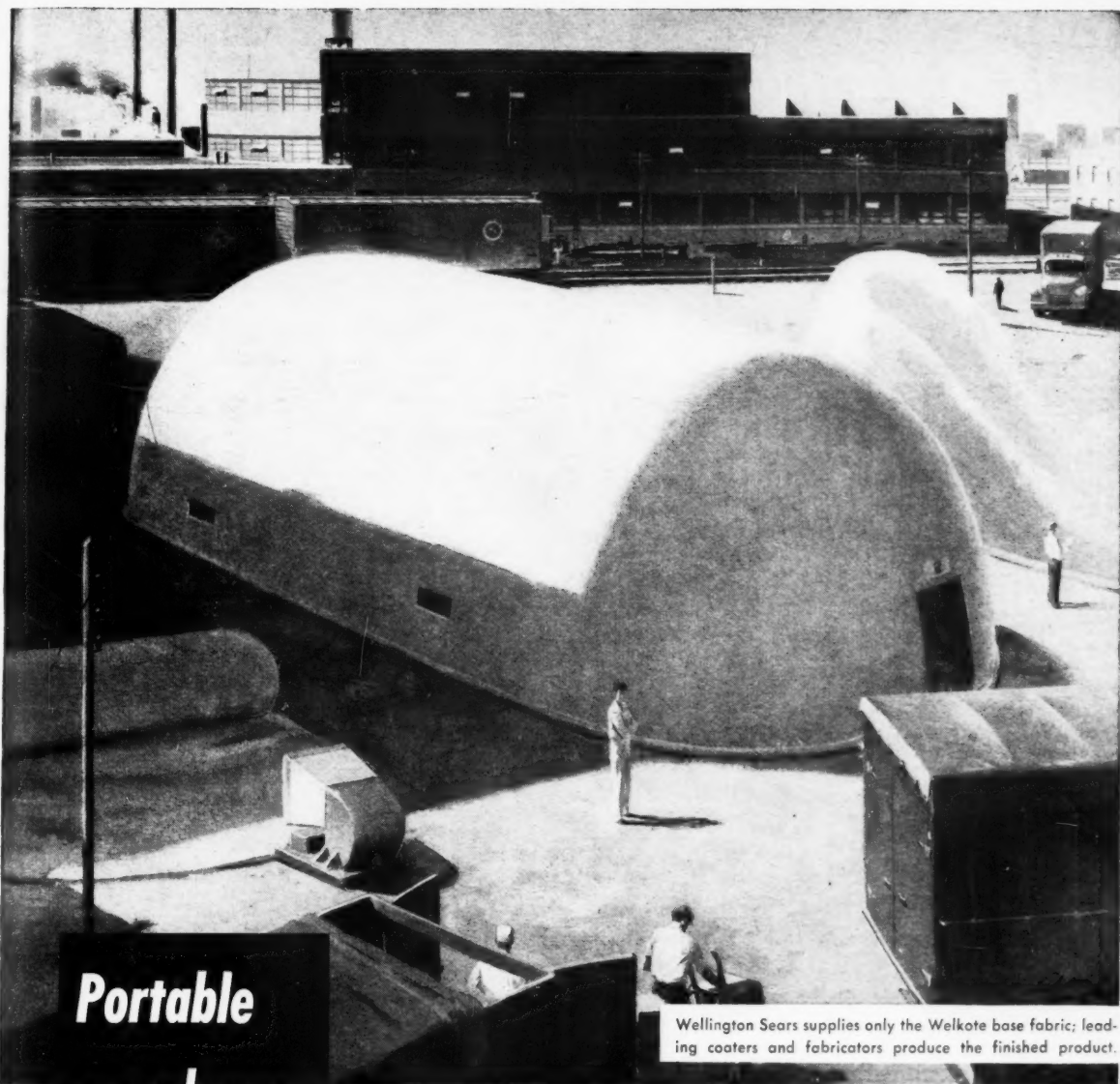
d

c.

l,

g-
 r,

ORLD



**Portable
 warehouse
 made
 of fabric
 "lives"
 on air!**

Wellington Sears supplies only the Welkote base fabric; leading coaters and fabricators produce the finished product.

No visible means of support: *air* does it! Now huge vinyl-coated nylon buildings can be easily packed, transported swiftly to a site, inflated on the spot, and start receiving goods for storage in a matter of hours. And constant, regulated air pressure keeps walls and roofs taut even when doors are open!

As in so many new industrial uses of textiles, the rugged nylon base fabric, *Welkote*, is produced by the mills of West Point Manufacturing Company and supplied by Wellington Sears. Welkote is engineered specifically as a base for vinyl and neoprene coating, and is just one aspect of our textile service to all kinds of industries, for all kinds of uses. We've been doing this for more than a century. Surely you can use this experience to help in solving *your* fabric problems!

For informative booklet, "Fabrics Plus," write Dept. H-8.

Wellington Sears

FIRST In Fabrics For Industry

For Mechanical Goods, Coated Materials, Tires,
 Footwear and Other Rubber Products



WEST POINT
 MANUFACTURING CO.

Wellington Sears Co., 65 Worth St., New York 13, N. Y. • Atlanta • Boston • Chicago • Dallas • Detroit • Los Angeles • Philadelphia • San Francisco • St. Louis

August, 1957

749

STATISTICS of the RUBBER INDUSTRY

U.S.A. Imports and Production of Natural (Including Latex and Guayule) and Synthetic Rubber (in Long Tons)

Year	Natural	GR-S	SBR-Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1948	735,227	390,240	15,252	56,662	34,848	7,012	1,239,241
1949	660,792	288,882	21,717	54,046	32,215	11,072	1,071,724
1950	802,249	350,801	28,086	60,915	50,067	12,037	1,304,155
1951	733,048	694,583	9,946	76,475	58,907	15,333	1,588,292
1952	805,997	636,969	17,885	81,630	65,745	16,228	1,624,454
1953	647,615	668,386	12,342	79,801	80,495	20,198	1,508,837
1954	596,848	472,698	17,707	58,802	69,150	21,396	1,236,601
1955	635,174	236,556	564,589	56,179	91,357	32,623	1,616,478
1956							
Jan.	58,803	.....	76,028	6,896	8,207	3,125	153,059
Feb.	56,497	.....	73,457	6,229	8,560	2,989	147,732
Mar.	52,749	.....	77,812	5,686	7,822	3,663	147,732
Apr.	51,394	.....	74,502	5,685	8,481	3,648	143,710
May	39,789	.....	78,309	5,647	7,795	2,903	134,443
June	36,694	.....	69,820	4,638	8,929	2,350	122,431
July	41,195	.....	70,831	7,192	7,935	2,460	129,613
Aug.	40,367	.....	70,122	7,118	7,769	2,141	127,517
Sept.	42,974	.....	73,321	7,252	8,328	2,322	134,197
Oct.	52,638	.....	70,690	7,018	8,144	2,973	141,463
Nov.	49,757	.....	66,482	6,065	8,614	3,092	134,010
Dec.	57,653	.....	76,056	6,496	8,828	2,921	151,954
Yr.-end adj.	+1,293	.....	.....	.....	.....	.....	+1,293
Total	580,510	.....	877,430	75,922	99,412	34,567	1,667,841
1957							
Jan.	46,349	.....	76,224	6,366	9,432	2,957	141,328
Feb.	37,487	.....	66,023	5,664	9,004	2,963	121,141
Mar.	40,680	.....	76,546	6,460	8,031	3,320	135,037
Apr.	59,896	.....	65,706	5,890	8,902	2,449	142,843
May*	.....	.....	77,124	6,094	9,234	2,560	.....

* Preliminary.

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

U.S.A. Consumption of Natural (Including Latex) and Synthetic Rubber (Long Tons)

Year	Natural	GR-S	SBR Types	Butyl	Neoprene	N-Type	Total Natural and Synthetic
1948	627,332	334,233	11,080	58,870	32,118	5,771	1,069,404
1949	574,522	299,420	21,717	52,664	31,753	8,827	988,903
1950	720,268	388,427	27,803	66,348	43,781	11,930	1,258,557
1951	454,015	617,200	9,244	70,500	48,887	13,066	1,212,912
1952	453,846	648,816	17,604	71,229	55,522	13,866	1,260,883
1953	553,473	611,748	12,433	77,826	65,900	16,929	1,338,309
1954	596,285	483,001	17,344	61,464	57,203	17,715	1,233,412
1955	634,800	234,963	507,034	53,991	72,876	26,035	1,529,699
1956							
Jan.	53,751	.....	65,375	4,223	6,684	2,198	132,231
Feb.	50,285	.....	62,366	4,155	6,430	2,289	125,525
Mar.	50,040	.....	64,458	4,515	6,542	2,373	127,928
Apr.	47,446	.....	62,179	4,228	6,125	2,150	122,128
May	48,342	.....	63,629	4,285	6,379	2,103	124,738
June	43,638	.....	56,390	4,026	5,536	1,864	111,454
July	38,353	.....	48,907	3,316	4,435	1,538	96,549
Aug.	46,700	.....	59,756	4,102	6,554	2,125	119,237
Sept.	44,179	.....	57,135	4,044	6,057	1,969	113,384
Oct.	52,188	.....	67,399	4,780	7,478	2,366	134,211
Nov.	42,946	.....	58,692	4,093	6,676	2,065	114,472
Dec.	45,220	.....	60,742	3,814	5,956	1,893	117,625
Yr.-end adj.	-1,000	.....	-3,000	.....	.....	+1,000	-3,000
Total	562,088	.....	724,028	49,581	74,852	25,933	1,436,482
1957							
Jan.	52,631	.....	70,978	5,028	7,237	2,247	138,121
Feb.	46,427	.....	64,322	4,581	6,235	2,122	123,687
Mar.	48,263	.....	67,853	4,998	6,559	2,240	129,913
Apr.	45,368	.....	63,280	4,651	6,295	2,129	121,723
May*	46,385	.....	66,515	4,915	6,474	2,026	126,315

* Preliminary.

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

netic

Natural
Synthetic

9,241
1,724
4,155
8,292
4,454
8,837
6,601
6,478

3,059
7,732
7,732
3,710
4,443
2,431
9,613
7,517
4,197
1,463
4,010
1,954
1,293

7,841

1,328
1,141
5,037
2,843

)

Natural
Synthetic

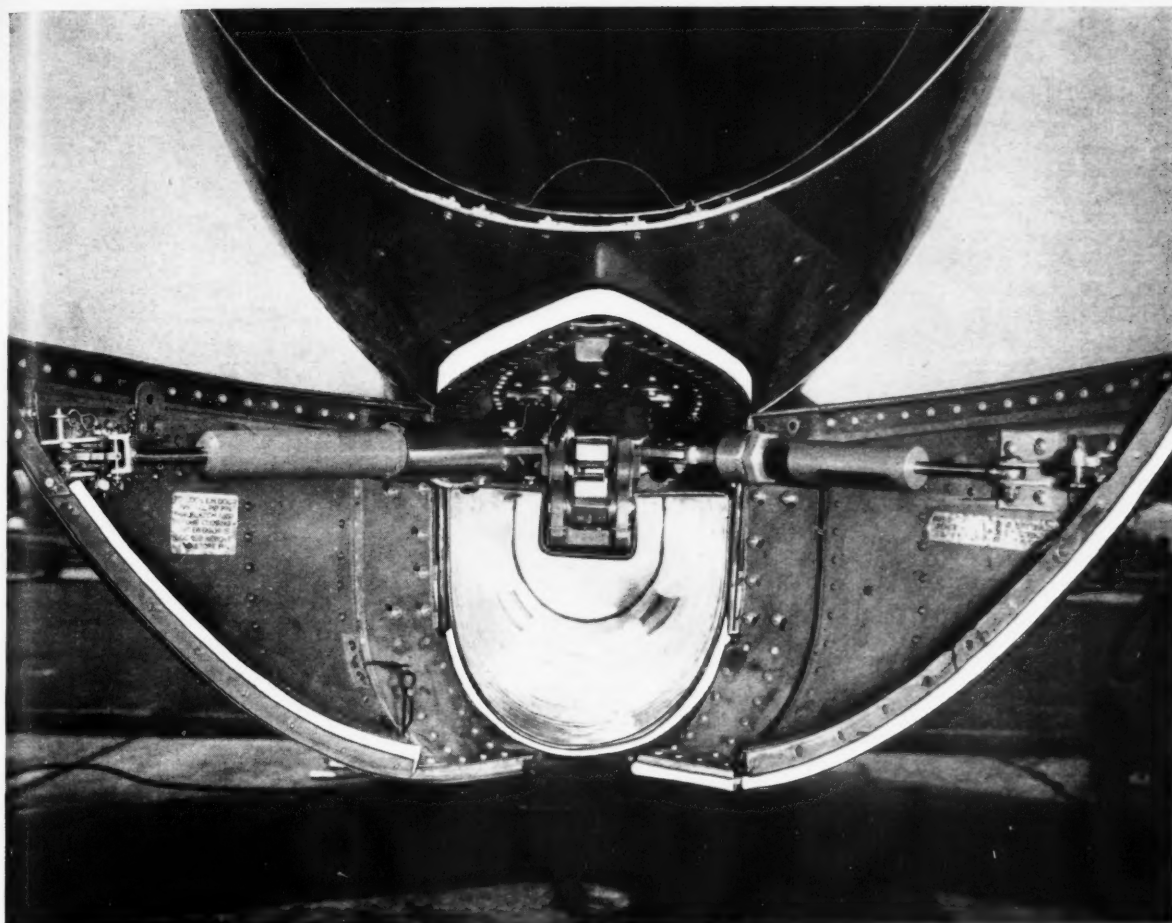
9,404
8,903
8,557
2,912
0,883
8,309
3,412
9,699

2,231
5,525
7,928
2,128
4,738
4,454
5,549
2,237
3,384
4,211
4,472
7,625
8,000

5,482

8,121
6,687
9,913
7,723
5,315

ORLD



SILASTIC 440 Gum

For Seals that Stay Resilient to -130 F

TYPICAL PROPERTIES OF LOW TEMPERATURE SEALS MADE WITH SILASTIC 440 GUM

Temperature range, °F	-130 to +500
Tensile strength, psi	900
Elongation, %	325
Tear strength, ppi	90
Compression set, %	30
Hardness, Durometer	50
Extrusion	Good

All properties obtained on ASTM slabs
molded 5 minutes at 240 F. and cured
4 hours at 300 F.

A team of compounding and fabricating
experts is available for visits to your
plant. If you would like this team to
work with your group, contact your
Dow Corning representative.

Compounding of stocks for seals that stay rubbery despite
prolonged exposure to bitter cold is easier with Silastic* 440
Gum. This Dow Corning silicone rubber gum is ideal for many
low-temperature applications. It has inherent low compression
set; provides excellent resistance to weathering, ozone and mois-
ture. Stocks made from Silastic 440 Gum can be extruded,
calendered or molded.

*Do you want the recipe and complete compound-
ing instructions for a general-purpose, low-temperature stock using
Silastic 440 Gum? Get your copy from the nearest Dow Corning
branch office and inquire about the improved technical assistance
available to you from our new fabrication laboratory.*

FREE SAMPLE . . . Try Silastic 440 Gum in your own plant.
Write today to Dept. 9420.

first in
silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

U.S. PAT. OFF.

ATLANTA BOSTON CHICAGO CLEVELAND DALLAS DETROIT LOS ANGELES NEW YORK WASHINGTON, D. C.
CANADA: DOW CORNING SILICONES LTD., TORONTO GREAT BRITAIN: MIDLAND SILICONES LTD., LONDON FRANCE: ST. GOBAIN, PARIS

August, 1957

751

U.S.A. Stocks of Synthetic Rubber

(Long Tons)

Year	SBR-Types	Butyl	Neoprene	N-Type	Total
1950	36,942	7,243	5,733	2,840	52,758
1951	105,271	12,481	8,379	3,821	129,952
1952	83,861	22,716	8,535	3,875	118,987
1953	135,153	24,866	11,480	4,346	175,845
1954	115,499	19,267	11,349	4,280	150,395
1955	108,989	10,500	12,220	6,030	137,739
1956					
Jan.	111,263	12,303	11,850	6,316	141,732
Feb.	114,389	13,027	11,888	6,602	145,906
Mar.	118,063	13,458	12,037	7,437	150,995
Apr.	121,054	14,071	12,042	8,243	155,370
May	127,163	15,253	11,478	8,788	162,682
June	133,570	15,744	12,927	8,955	171,196
July	145,601	18,899	15,084	9,229	188,813
Aug.	148,176	21,267	14,540	8,503	192,486
Sept.	154,841	23,862	14,055	8,035	200,793
Oct.	151,646	25,734	12,841	7,567	197,788
Nov.	151,143	26,998	13,459	7,734	199,334
Dec.	151,934	28,685	14,043	7,934	202,596
Yr.-end.				+250	+250
adj.					
	151,934	28,685	14,043	8,184	202,846
1957					
Jan.	143,177	29,810	13,073	7,664	193,724
Feb.	134,587	29,951	12,705	7,565	184,808
Mar.	131,255	30,814	11,949	7,795	181,813
Apr.	122,764	31,536	12,064	7,247	173,611
May*	122,396	31,951	12,904	6,862	174,113

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

U.S.A. Stocks of Latex

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1950	4,927	5,504	532	902	6,961	10,286
1951	4,752	5,040	1,019	1,117	7,178	13,162
1952	6,201	4,794	1,117	811	7,032	20,164
1953	11,133	5,134	1,087	1,807	10,023	18,165
1954	13,203	6,980	1,236	1,807	10,023	23,226
1955						
Jan.	16,059	6,522	1,093	1,906	9,521	25,580
Feb.	16,735	7,011	1,162	1,943	10,116	26,851
Mar.	18,309	6,867	1,097	2,340	10,304	28,613
Apr.	21,384	7,415	1,163	2,272	10,850	32,234
May	21,234	7,516	1,218	2,194	10,928	32,162
June	21,033	7,447	1,328	2,086	10,861	31,894
July	19,952	7,288	1,109	2,009	10,406	30,358
Aug.	18,099	6,402	1,076	1,703	9,181	27,280
Sept.	15,403	6,625	1,328	1,523	9,476	24,879
Oct.	12,322	5,703	1,263	1,680	8,646	20,968
Nov.	11,148	6,282	1,233	1,939	9,454	20,602
Dec.	12,262	7,327	1,421	2,017	10,765	23,027
Yr.-end.				+200	+200	+200
adj.						
	12,262	7,327	1,421	2,217	10,965	23,227
1957						
Jan.	11,831	7,191	1,329	1,936	10,456	22,287
Feb.	9,940	7,415	1,169	2,051	10,635	20,575
Mar.	10,173	7,689	1,170	2,157	11,016	21,189
Apr.	12,064	8,096	1,183	1,826	11,115	23,179
May*	11,730	8,197	1,262	1,273	10,732	22,462

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Includes SBR-Types.
† Preliminary.

U.S.A. Imports and Production of Natural and Synthetic Latexes

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1950	54,401	31,339	5,725	2,948	37,064	91,465
1951	54,963	32,972	6,866	2,948	42,786	97,749
1952	48,228	42,273	7,598	4,164	54,035	102,263
1953	75,511	48,112	9,026	5,844	62,982	138,493
1954	74,483	48,379	8,214	6,866	63,459	137,942
1955						
Jan.	7,853	6,199	617	708	7,524	15,377
Feb.	6,110	5,634	797	525	6,956	13,066
Mar.	7,611	7,078	854	738	8,670	16,281
Apr.	8,550	5,680	975	972	7,627	16,177
May	8,849	5,337	880	815	7,032	15,881
June	7,736	4,777	905	1,450	7,132	14,868
July	8,702	4,800	641	951	6,392	15,094
Aug.	8,885	4,519	881	1,010	6,410	15,295
Sept.	8,109	5,769	994	1,091	7,854	15,963
Oct.	6,900	6,231	922	883	8,036	14,936
Nov.	7,085	6,933	1,004	781	8,718	15,803
Dec.	6,364	6,407	962	874	8,243	14,607
Total	92,754	69,364	10,432	10,798	90,594	183,348
1956						
Jan.	10,328	6,885	848	919	8,652	18,980
Feb.	7,965	6,943	930	827	8,700	16,665
Mar.	7,800	5,911	782	1,158	7,851	15,651
Apr.	6,995	6,097	969	866	7,922	14,917
May	5,731	4,966	939	614	6,519	12,250
June	5,006	4,776	907	543	6,226	11,232
July	3,522	4,241	444	731	5,416	8,938
Aug.	4,715	4,902	882	684	6,468	11,183
Sept.	2,790	5,723	1,180	938	7,841	10,631
Oct.	5,738	6,122	908	1,183	8,213	13,951
Nov.	4,761	6,053	886	1,175	8,114	12,875
Dec.	6,661	7,143	967	1,012	9,122	15,783
Yr.-end.						
adj.	-294					-294
Total	71,718	69,762	10,642	10,650	91,054	162,772
1957						
Jan.	6,460	7,270	905	960	9,135	15,595
Feb.	4,342	6,491	724	1,035	8,250	12,592
Mar.	5,856	7,268	924	1,127	9,319	15,175
Apr.	8,812	6,348	976	881	8,205	17,017
May*		5,495	1,081	932	7,508	

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Includes SBR-Types.
† Preliminary.

U.S.A. New Supply, Consumption, Exports, and Stock of Reclaimed Rubber

(Long Tons)

Year	New Supply	Consumption	Exports	Stocks
1950	314,008	303,733	11,740	35,708
1951	366,700	346,121	14,722	45,082
1952	274,981	280,002	11,180	30,664
1953	298,336	285,050	11,397	32,319
1954	258,101	249,049	10,232	30,746
1955				
Jan.	25,336	25,322	1,041	29,656
Feb.	25,444	24,333	1,085	30,125
Mar.	29,574	28,674	1,088	30,311
Apr.	26,817	26,609	1,088	30,068
May	27,911	27,652	1,056	29,528
June	30,451	29,157	1,128	29,725
July	24,114	22,563	1,176	29,939
Aug.	25,223	25,790	1,144	27,956
Sept.	26,512	26,340	1,018	27,110
Oct.	28,038	26,597	1,381	27,565
Nov.	29,124	27,229	1,313	28,473
Dec.	28,105	24,515	1,470	31,058
Year-end adj.		-2,000		+440
Total	326,649	312,781	13,988	31,498
1956				
Jan.	26,205	25,827	1,382	31,640
Feb.	27,108	25,571	1,115	31,875
Mar.	28,468	26,176	1,163	33,326
Apr.	26,933	23,999	1,179	34,360
May	25,485	23,560	1,297	34,863
June	22,153	20,560	1,264	35,647
July	19,776	18,099	952	35,703
Aug.	21,724	21,498	1,076	35,512
Sept.	22,368	20,242	1,015	36,527
Oct.	26,318	23,946	1,298	37,904
Nov.	20,009	20,832	1,189	36,063
Dec.	20,673	20,737	902	34,969
Year-end adj.		-500		
Total	287,220	270,547	13,832	34,969
1957				
Jan.	25,103	24,053	1,288	34,552
Feb.	21,896	22,773	1,263	32,010
Mar.	25,088	24,633	1,298	30,975
Apr.	22,878	23,145	1,201	30,258
May*	24,753	23,713		29,589

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary.

UNIFORMLY CUT PELLETS

Without Fines or Longs

with TAYLOR-STILES PLASTIC PELLETIZERS

700 Series Taylor-Stiles Multi-Knife Plastic Pelletizers produce plastic pellets which are uniform in size, clean, and free from feathers.

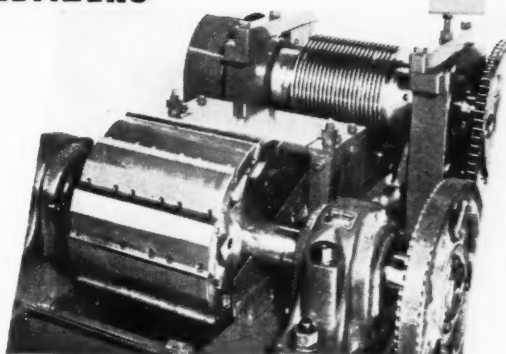
They will cut either extruded rods, which are diced directly into pellets, or sheet stock, which is first slit into strips and then cross cut into pellets.

These machines are being used by several of this country's leading manufacturers.

If you want plastic or rubber pellets in large volume of uniform size it will pay you to get further details about the 700 Series pelletizers. A Taylor-Stiles Pelletizer has cut as much as 10 tons of plastic pellets per hour.

Write today for four-page illustrated, two-color descriptive folders about our Plastic Cutters—no obligation.

#213 FOLDER TELLS ALL ABOUT TAYLOR-STILES PLASTIC PELLETIZERS.



Taylor, Stiles & Co.
16 Bridge Street
Riegelsville, N. J.

Gentlemen:

Please send me Folder #213 giving full details of your plastic pelletizers.

Name

Company

City State

TAYLOR, STILES & COMPANY

16 BRIDGE STREET, RIEGELSVILLE, NEW JERSEY



THE STAMFORD RUBBER SUPPLY CO.

Factice®

A COMPLETE LINE OF
WHITE
BROWN
and AMBER
GRADES

LEADERS IN THE FIELD
For
RESEARCH and
MANUFACTURING
DEPENDABILITY

OLDEST AND LARGEST MANUFACTURERS
OF *Factice* VULCANIZED OIL
SINCE 1900

THE STAMFORD RUBBER SUPPLY COMPANY, STAMFORD, CONN.

U.S.A. Consumption of Natural and Synthetic Latexes

(Long Tons, Dry Weight)

Year	Natural	GR-S*	Neoprene	N-Type	Total Synthetic	Total Natural & Synthetic
1955	86,478	63,982	8,736	8,495	81,213	167,691
1956						
Jan.	6,776	5,858	772	670	7,300	14,076
Feb.	6,399	5,913	787	730	7,430	13,829
Mar.	6,438	5,888	729	781	7,398	13,836
Apr.	5,693	4,923	741	692	6,356	12,049
May	5,239	4,745	778	691	6,214	11,453
June	5,171	4,350	637	657	5,644	10,815
July	4,855	3,731	562	466	4,759	9,614
Aug.	6,374	5,055	816	698	6,569	12,943
Sept.	6,233	4,937	692	699	6,328	12,561
Oct.	7,825	6,175	795	681	7,651	15,476
Nov.	6,431	5,406	723	659	6,788	13,219
Dec.	6,666	5,399	701	710	6,810	13,476
Yr.-end adj.	-1,000	+3,000	.....	+800	+3,800	+2,800
Total	73,100	65,380	8,733	8,934	83,047	156,147
1957						
Jan.	6,994	6,288	856	841	7,985	14,979
Feb.	6,398	5,894	758	708	7,360	13,758
Mar.	7,081	6,370	784	799	7,953	15,034
Apr.	6,434	5,554	772	710	7,036	13,470
May*	5,818	4,952	813	582	6,347	12,165

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.
* Preliminary. * Includes SBR-Types.

U.S.A. Synthetic Rubber Industry, Wages, Hours

Year	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings
1953	\$87.29	40.6	\$2.15
1954	90.76	40.7	2.23
1955	97.81	41.8	2.34
1956			
Jan.	101.88	42.1	2.42
Feb.	101.57	41.8	2.43
Mar.	102.51	41.5	2.47
Apr.	102.75	41.6	2.47
May	103.00	41.2	2.50
June	103.41	41.2	2.51
July	103.41	41.5	2.50
Aug.	108.03	42.2	2.56
Sept.	104.90	41.3	2.54
Oct.	107.52	42.0	2.56
Nov.	103.57	41.1	2.52
Dec.	107.33	41.6	2.58
1957			
Jan.	106.30	41.2	2.58
Feb.	104.19	40.7	2.56
Mar.	104.86	40.8	2.57

Source: BLS, United States Department of Labor.

U.S.A. Exports of Synthetic Rubber

(Long Tons)

Year	SBR-Types	Butyl	Neoprene	N-Type	Total
1955	60,704	9,895	18,098	4,593	93,290
1956					
Jan.	7,550	815	1,757	506	10,628
Feb.	9,018	1,624	1,521	449	12,612
Mar.	10,804	764	1,500	522	13,590
Apr.	10,271	374	1,917	587	13,149
May	10,864	743	2,142	443	14,192
June	9,558	746	2,088	548	12,940
July	9,038	523	1,994	433	11,988
Aug.	9,607	654	2,268	274	12,803
Sept.	8,804	439	2,824	403	12,470
Oct.	6,795	454	1,013	618	8,880
Nov.	4,789	247	1,076	551	6,643
Dec.	15,268	1,316	1,829	860	19,273
Total	112,366	8,699	21,909	6,194	149,168
1957					
Jan.	13,989	207	2,500	540	17,236
Feb.	13,353	439	2,505	482	16,779
Mar.	13,664	1,014	2,466	781	17,925
Apr.	10,625	372	2,244	620	13,861

Source: Chemical & Rubber Division, Business & Defense Services Administration, United States Department of Commerce.

Carbon Black Statistics—First Five Months, 1957

Furnace blacks are classified as follows: SRF, Semi-reinforcing furnace black; HMF, high modulus furnace black; FEF, fast-extruding furnace black; HAF, high abrasion furnace black; SAF, super abrasion furnace black; ISAF, intermediate super abrasion furnace black.

(Thousands of Pounds)

Production	Jan.	Feb.	Mar.	Apr.	May
Furnace types					
Thermal	13,200	10,064	12,147	13,533	14,395
SRF	26,328	21,623	27,167	24,726	24,216
HMF	11,112	10,898	10,292	10,105	11,052
FEF	17,125	13,340	20,439	18,621	19,809
HAF	42,186	34,730	41,201	35,038	40,048
SAF, ISAF	16,348	15,246	18,864	15,213	15,512
Total furnace	126,299	105,901	130,110	117,236	125,032
Contact types	31,563	27,792	30,726	29,879	30,733
Totals	157,862	133,693	160,836	147,115	155,765
Shipments					
Furnace types					
Thermal	13,499	11,726	12,442	12,556	11,488
SRF	25,864	24,246	37,063	19,359	21,453
HMF	10,517	10,273	13,449	9,584	9,695
FEF	21,080	17,685	26,129	14,441	18,918
HAF	38,446	37,049	55,187	30,348	40,524
SAF, ISAF	15,978	14,692	20,562	15,622	15,505
Total furnace	125,384	115,671	164,832	101,910	117,583
Contact types	35,688	32,565	42,196	28,276	25,916
Totals	161,072	148,236	207,028	130,186	143,499
Producers' Stocks, End of Period					
Furnace types					
Thermal	18,478	16,816	16,521	17,498	20,405
SRF	76,472	73,781	63,885	69,252	72,015
HMF	20,163	20,788	17,631	18,152	19,509
FEF	29,362	25,006	19,316	23,496	24,387
HAF	60,018	57,699	43,713	48,403	47,927
SAF, ISAF	56,740	57,373	55,675	55,266	55,273
Total furnace	261,233	251,463	216,741	232,067	239,516
Contact types	73,385	68,612	57,142	58,745	63,562
Totals	334,618	320,075	273,883	290,812	303,078
Exports					
Furnace types					
Total furnace	18,605	23,722	23,357	30,550	
Contact types	18,306	21,218	15,888	19,832	
Totals	36,911	44,940	39,245	50,382	

Source: Bureau of Mines, United States Department of the Interior, Washington, D. C.

U.S.A. Rubber Industry Sales and Inventories

(Million of Dollars)

	Value of Sales*				Manufacturers' Inventories*			
	1954	1955	1956	1957	1954	1955	1956	1957
Jan.	348	424	415	474	844	790	935	995
Feb.	351	440	445	476	857	782	970	985
Mar.	388	466	451	476	849	805	979	989
Apr.	375	445	445	...	812	784	970	...
May	357	465	464	...	810	810	985	...
June	377	465	450	...	829	850	975	...
July	374	471	459	...	784	853	987	...
Aug.	337	456	436	...	761	863	1,007	...
Sept.	334	456	429	...	804	874	1,007	...
Oct.	332	447	454	...	838	902	1,022	...
Nov.	388	482	463	...	819	935	1,024	...
Dec.	407	465	461	...	929	934	998	...
Total	4,368	5,493	5,372	...	Av. 831	845	988	...

Source: Office of Business Economics, U. S. Department of Commerce.
* Adjusted for seasonal variation.

RC plasticizer

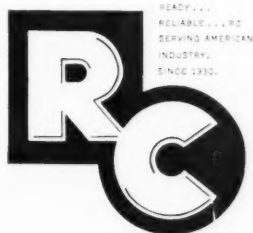
TC-8

for low temperature flexibility

in synthetic and natural rubbers

- Superior Flex
- Reduced Nerve
- Low Volatile Loss
- Smooth Extrusions

Other RC Plasticizers for the rubber industry include Adipates, Sebacates, DBP, Butyl Oleate, TG-9 and BD-8.



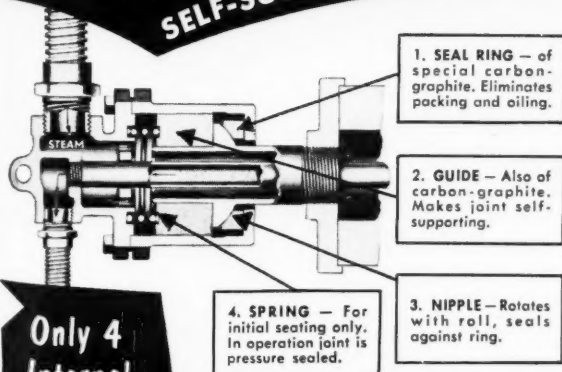
WRITE FOR SAMPLES!

RUBBER CORPORATION OF AMERICA
New South Road, Hicksville 3, N. Y.

Sales Offices: NEW YORK • AKRON • CHICAGO • BOSTON

JOHNSON Rotary Pressure JOINT

SELF-SUPPORTING TYPE



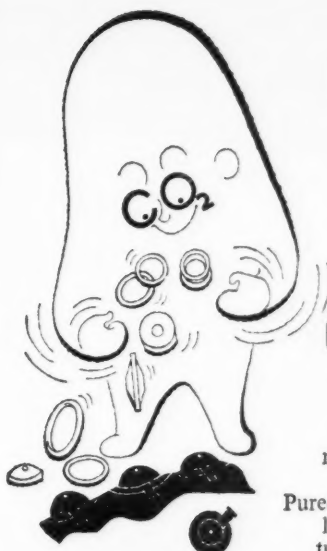
For introducing steam and liquids into rotating rolls and cylinders, there's nothing like the Johnson Joint above. It's packless, self-lubricating, self-adjusting, self-supporting. It has been

adopted by dozens of machinery makers, and is finding new uses every day.

Type SB shown handles both steam and condensate through same head; also available for through flow service, and in sizes and styles for all operating conditions. **Write for literature.**

The Johnson Corporation

869 Wood St., Three Rivers, Mich.



Deflashing costs too high?
Tumble rubber parts using
PURECO CRUSHED "DRY-ICE" or CO₂ LIQUID

Deflashing of molded rubber parts can now be done in minutes with Pureco "DRY-ICE" or CO₂ liquid in Pureco rubber tumblers. It's simple... inexpensive!

Pureco Technical Sales Service will be glad to study your problem and recommend the best technique for solving it. Call your Pureco Representative today!



Pure Carbonic Company

A Division of Air Reduction Company, Incorporated

Nationwide "Dry-Ice" service-distributing stations in principal cities
GENERAL OFFICES: 150 EAST 42nd STREET, NEW YORK 17, N. Y.

AT THE FRONTIERS OF PROGRESS YOU'LL FIND AN AIR REDUCTION PRODUCT



COMPLETE ENGINEERING SERVICE
for

The Rubber and Plastics Industries

Factory Layouts, Machinery, and Equipment

Extruders, Mills and Calenders
Vulcanizing and Laminating Presses
Tire Building and Curing Equipment
Wire and Cable Machinery
Coating and Laminating Equipment
Rayon and Nylon Treating Trains
Trimming and Cutting Machines
Foam Rubber Dosers and Blenders
Rotational Casting Machines

Write, Telephone, or Wire Your Inquiries.

CONTINENTAL MACHINERY CO., INC.

261 Broadway, New York 7, N. Y.

Telephone: Worth 2-1650 • Cable: CONTIMAC

World Production of Synthetic Rubber

(1,000 Long Tons)				
Year	U.S.A.	Canada	Germany	Total
1955	970.5	103.9	10.9	1,085.3
1956				
Jan.	93.5	9.7	1.0	104.3
Feb.	90.5	8.2	1.0	99.7
Mar.	94.4	10.3	1.1	105.8
Apr.	91.6	10.3	1.0	102.8
May	93.7	10.6	1.0	105.3
June	85.3	10.4	0.6	96.3
July	88.0	8.7	1.0	97.7
Aug.	86.5	10.2	0.9	97.6
Sept.	90.6	10.7	0.8	102.1
Oct.	88.2	10.7	0.8	99.7
Nov.	83.5	10.3	0.8	94.7
Dec.	93.8	10.6	0.8	105.2
Total	1,079.6	120.7	10.7	1,211.0
1957				
Jan.	94.3	11.1	0.9	106.2
Feb.	83.2	9.8	1.1	94.1
Mar.	93.9	11.1	1.1	106.1
Apr.	82.3	11.0		

Source: Secretariat of the International Rubber Study Group; and BDSA, United States Department of Commerce.

World Production of Natural Rubber

(1,000 Long Tons)						
Year	Malaya		Indonesia		All Other	Total
	Estate	Native	Estate	Native		
1955	352.9	286.2	261.3	472.4	521.2	1,895.0
1956						
Jan.	32.6	26.5	23.5	17.4	42.5	142.5
Feb.	27.6	24.3	23.0	20.9	36.7	132.5
Mar.	28.5	22.5	21.5	16.4	41.1	130.0
Apr.	26.7	21.7	20.0	46.1	40.4	155.0
May	23.5	19.8	18.0	38.4	37.8	137.5
June	29.5	23.2	21.9	25.9	44.5	145.0
July	30.8	23.9	21.3	41.5	45.0	162.5
Aug.	30.3	23.0	20.3	64.0	44.9	182.5
Sept.	30.2	21.9	21.3	29.0	42.6	145.0
Oct.	30.5	22.5	22.0	34.0	53.5	162.5
Nov.	28.4	21.3	21.9	44.4	51.5	167.5
Dec.	34.7	24.2	23.0	49.5	53.6	185.0
Total	353.0	274.4	258.2	428.5	558.4	1,872.5
1957						
Jan.	36.1	27.3	23.8	22.7	45.1	155.0
Feb.	27.1	22.1	20.6	16.4	38.8	125.0
Mar.	26.0	21.1	19.7	46.1	52.1	165.0
Apr.	26.6	22.5	19.7			

Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.

World Consumption of Natural Rubber

(1,000 Long Tons)					
Year	United States	U.S.S.R.* and China	United Kingdom	Other Foreign	Total Foreign
1955	634.8	56.2	246.3	900.2	1,202.7
1956					
Jan.	53.4	14.4	21.7	73.0	109.1
Feb.	50.1	19.1	17.9	72.9	109.9
Mar.	49.6	11.7	16.0	73.7	100.4
Apr.	47.0	14.6	18.4	72.5	105.5
May	48.3	16.8	14.5	75.4	106.7
June	43.6	20.8	16.1	82.0	118.9
July	38.4	16.6	14.7	75.3	106.6
Aug.	46.7	7.1	10.3	73.4	90.8
Sept.	44.2	17.1	14.5	81.7	113.3
Oct.	52.2	15.5	18.8	76.0	110.3
Nov.	43.0	27.2	15.7	76.6	119.5
Dec.	45.2	29.9	14.3	73.1	117.3
Total	563.1	215.0	192.8	914.1	1,321.9
1957					
Jan.	52.6	6.3	14.4	79.2	99.9
Feb.	46.8	14.5	14.5	81.7	110.7
Mar.	48.3	12.7	17.6	81.4	111.7
Apr.	45.1	28.5	13.6	77.8	119.9
Total					1,885.0

Source: BDSA, United States Department of Commerce; Secretariat of the International Rubber Study Group; and United Baltic Corp., Ltd.
* Estimated.

U.S.A. Synthetic Rubber Exports, by Country (Including Latexes)

January, 1957 (Long Tons)					
Country	SBR-Type	Butyl	Neoprene	N-Type	Total
U.K.	1,431	12	389	27	1,859
Belgium	308		314	12	634
France	3,033	15	673	72	3,793
Germany	1,963		381	131	2,475
Italy	356	58	16	33	463
Spain	321				321
Sweden	273	14	5	76	368
Switzerland	849		78		927
Argentina	306	44		12	362
Australia	1,251		2	8	1,261
Canada	861		254	15	1,130
Japan	643		266	109	1,018
South Africa	785	46	18	3	852
All others	1,709	19	104	42	1,773
Total	13,989	207	2,500	540	17,236

Source: Secretariat of the International Rubber Study Group.

World Consumption of Synthetic Rubber*

(1,000 Long Tons)				
Year	U.S.A.	Canada	United Kingdom	Total†
1955	894.9	40.2	20.5	78.3
1956				
Jan.	78.5	4.0	3.1	9.0
Feb.	75.2	4.1	3.1	9.0
Mar.	78.3	4.1	3.1	9.0
Apr.	73.7	4.4	3.6	8.8
May	76.4	4.5	3.2	8.5
June	67.8	4.0	3.6	9.5
July	58.2	3.7	2.9	8.8
Aug.	72.5	3.3	2.3	7.5
Sept.	69.2	3.9	3.2	9.0
Oct.	82.0	4.2	4.1	10.8
Nov.	71.5	4.3	3.9	10.5
Dec.	73.3	3.8	3.6	9.8
Total	877.3	48.4	39.5	110.5
1957				
Jan.	85.5	4.4	3.7	11.5
Feb.	77.9	4.2	3.9	11.3
Mar.	81.7	4.3	5.4	11.5
Apr.	76.1	4.2	4.0	

Source: Secretariat of the International Rubber Study Group; BDSA, United States Department of Commerce.

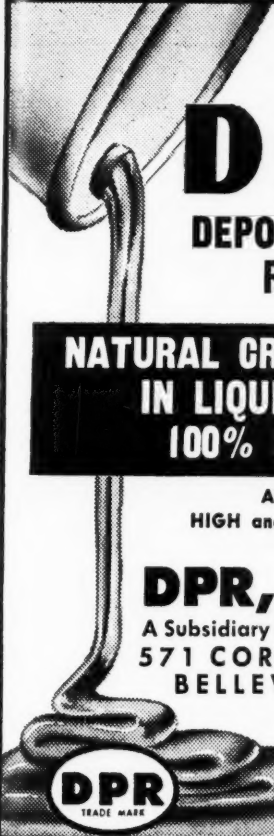
* Includes latexes.

† Figures estimated or partly estimated.

U.S.A. Automotive Inner Tubes

(Thousands of Units)					
Year	Shipments			Production	Inventory End of Period
	Original Equipment	Replacement	Export		
1954	25,090	35,442	948	61,480	58,397
1955	5,002	33,360	999	39,363	35,900
1956					
Jan.	274	3,263	72	3,608	2,918
Feb.	273	2,548	100	2,921	2,969
Mar.	282	2,587	93	2,962	3,347
Apr.	265	2,444	88	2,797	3,094
May	280	2,515	80	2,878	3,093
June	269	3,023	79	3,370	2,837
July	248	3,055	82	3,384	2,300
Aug.	242	2,954	99	3,295	2,795
Sept.	213	2,472	91	2,777	2,774
Oct.	261	2,514	102	2,877	3,025
Nov.	259	2,468	65	2,792	2,585
Dec.	235	2,515	87	2,838	2,670
Total	3,101	32,358	1,041	36,499	34,407
1957					
Jan.	274	3,263	72	3,608	2,918
Feb.	267	2,964	61	3,292	3,362
Mar.	240	3,057	100	3,397	3,822
Apr.	311	2,708	85	3,104	3,478
May	301	2,829	84	3,214	3,548

Source: The Rubber Manufacturers Association, Inc.



DPR[®]
DEPOLYMERIZED
RUBBER

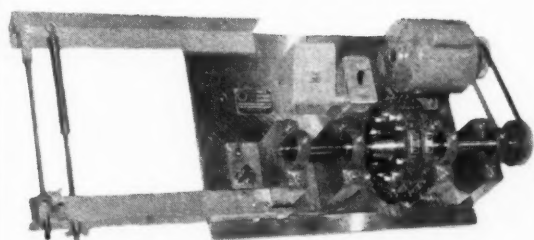
NATURAL CRUDE RUBBER
IN LIQUID FORM
100% SOLIDS

AVAILABLE IN
 HIGH and LOW VISCOSITIES

DPR, INCORPORATED
 A Subsidiary of H. V. HARDMAN CO.
 571 CORTLANDT STREET
 BELLEVILLE 9, N. J.

DPR
 TRADE MARK

B. F. GOODRICH
DISC COMPRESSION
CORD TESTER



Indicates most accurately simulated road
 test results of cord flexure and failure.

Exclusive Manufacturers

FERRY MACHINE CO., KENT, OHIO

Export Sales Through Columbian Carbon, Intl.

Industrial
Textiles

such as:

TIRE FABRICS
HOSE AND BELT DUCKS
CHAFERS
LAUNDRY TEXTILES
SEWING TWINES
CORDAGE
YARNS
COATING FABRICS
SHEETINGS

other available facilities:

BLEACHING
DYEING
FINISHING
SEWING

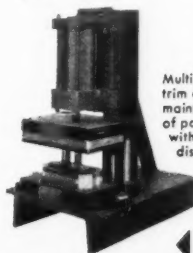
We solicit your inquiries

THOMASTON MILLS

THOMASTON • GEORGIA
 NEW YORK OFFICE: 40 WORTH STREET
 Phone: WOrth 2-6730

DO IT RIGHT...
DIE IT *Western*

Western die engineers are solving production problems in a variety of industries daily. Why not let us help you solve yours? There's no obligation. Just send us a pattern, blue print or sample of the job you want done. If there is a way to do it we'll find it. Send today for our free catalog.



Air Cylinder equipment. Also dies adaptable to customers punch press.

WESTERN SUPPLIES Company

2922 CASS AVE., SAINT LOUIS 8, MO.

U.S.A. Automotive Pneumatic Casings

(Thousands of Units)

	Shipments				Production	Inventory End of Period
	Original Equipment	Re- place- ment	Export	Total		
Passenger Car						
1956						
Jan. . . .	2,958	4,040	66	7,064	7,661	16,546
Feb. . . .	2,919	3,387	90	6,396	7,571	17,701
Mar. . . .	3,027	4,372	65	7,464	7,812	18,096
Apr. . . .	2,787	4,994	67	7,847	7,530	17,649
May	2,349	5,203	65	7,617	7,628	17,714
June	2,162	5,659	64	7,885	6,600	16,444
July	2,471	5,482	73	8,026	5,669	14,088
Aug.	1,953	5,359	77	7,389	6,897	13,578
Sept.	1,262	4,427	70	5,758	6,647	14,468
Oct.	2,530	3,854	87	6,471	7,526	15,607
Nov.	3,179	3,255	62	6,496	6,580	15,596
Dec.	3,277	3,220	90	6,587	7,425	16,494
Total	30,874	42,411	876	85,000	95,546	
1957						
Jan.	3,192	4,521	100	7,812	8,296	16,978
Feb.	3,017	4,453	68	7,538	8,047	17,376
Mar.	3,051	4,875	80	8,006	8,629	18,065
Apr.	2,809	5,218	78	8,104	7,878	17,821
May	2,831	5,166	60	8,057	8,313	18,050
Truck and Bus						
1956						
Jan.	444	629	65	1,139	1,318	2,971
Feb.	424	565	88	1,077	1,326	3,232
Mar.	439	662	62	1,163	1,382	3,465
Apr.	430	767	74	1,271	1,303	3,483
May	421	777	65	1,264	1,358	3,582
June	372	968	65	1,404	1,329	3,504
July	362	837	73	1,272	1,073	3,306
Aug.	349	820	86	1,254	1,154	3,217
Sept.	291	811	92	1,194	1,153	3,180
Oct.	378	849	78	1,305	1,273	3,168
Nov.	337	626	59	1,022	1,060	3,207
Dec.	301	583	76	961	1,130	3,378
Total	4,548	8,894	883	14,326	14,589	
1957						
Jan.	305	678	83	1,066	1,208	3,512
Feb.	344	598	59	1,001	1,122	3,633
Mar.	330	704	74	1,107	1,136	3,678
Apr.	438	771	49	1,277	1,072	3,486
May	399	620	74	1,094	1,178	3,580
Total Automotive						
1956						
Jan.	3,402	4,669	131	8,203	8,979	19,517
Feb.	3,343	3,953	178	7,473	8,897	20,934
Mar.	3,466	5,034	127	8,627	9,193	21,562
Apr.	3,217	5,761	141	9,119	8,834	21,132
May	2,770	5,980	130	8,880	8,987	21,296
June	2,533	6,627	129	9,289	7,930	19,947
July	2,833	6,319	146	9,298	6,741	17,394
Aug.	2,303	6,179	163	8,644	8,050	16,795
Sept.	1,553	5,238	162	6,952	7,800	17,648
Oct.	2,908	4,703	165	7,776	8,799	18,775
Nov.	3,516	3,881	121	7,518	7,641	18,803
Dec.	3,579	3,803	166	7,548	8,556	19,872
Total	35,423	62,147	1,759	99,327	100,407	
1957						
Jan.	3,496	5,199	183	8,878	9,504	20,490
Feb.	3,361	5,052	127	8,539	9,169	21,009
Mar.	3,381	5,579	154	9,114	9,766	21,743
Apr.	3,246	5,989	146	9,381	8,950	21,308
May	3,230	5,787	134	9,150	9,490	21,630

Sources: The Rubber Manufacturers Association, Inc.

U.S.A. Rubber Industry Employment, Wages, Hours

Year	Production Workers (1000's)	Average Weekly Earnings	Average Weekly Hours	Average Hourly Earnings	Consumers Price Index
All Rubber Products					
1939	121	\$27.84	39.9	\$0.75	
1954	195	78.21	39.7	1.97	114.8
1955	216.3	87.57	41.7	2.10	114.5
1956					
Jan.	232.5	87.91	40.7	2.16	114.6
Feb.	227.6	85.81	40.1	2.14	114.6
Mar.	224.7	84.93	39.5	2.15	114.7
Apr.	224.6	85.79	39.9	2.15	114.9
May	215.9	86.18	39.9	2.16	115.4
June	211.3	84.93	39.5	2.15	116.2
July	207.3	86.15	39.7	2.17	117.0
Aug.	209.3	87.64	40.2	2.18	116.8
Sept.	216.6	89.51	40.5	2.21	117.1
Oct.	217.7	90.17	40.8	2.21	117.7
Nov.	206.0	88.70	40.5	2.19	117.8
Dec.	217.9	93.15	41.5	2.25	118.0
1957					
Jan.	222.0	92.48	41.1	2.25	118.2
Feb.	221.5	91.21	40.9	2.23	118.7
Mar.	218.3	90.13	40.6	2.22	118.9
Apr.	201.6				119.3
Tires and Tubes					
1939	54.2	\$33.36	35.0	\$0.96	
1954	79.7	87.85	38.7	2.27	
1955	90.2	101.09	41.6	2.43	
1956					
Jan.	94.1	101.00	40.4	2.50	
Feb.	93.7	97.71	39.4	2.48	
Mar.	93.3	97.89	39.0	2.51	
Apr.	91.8	98.00	39.2	2.50	
May	91.6	99.00	39.8	2.51	
June	90.1	98.25	39.3	2.50	
July	90.8	98.14	39.1	2.51	
Aug.	89.8	101.20	40.0	2.53	
Sept.	91.6	102.51	40.2	2.55	
Oct.	91.7	102.66	40.1	2.56	
Nov.	74.8	103.53	40.6	2.55	
Dec.	93.2	109.25	41.7	2.62	
1957					
Jan.	93.8	108.94	41.9	2.60	
Feb.	92.9	106.19	41.0	2.59	
Mar.	93.7	103.42	40.4	2.56	
Rubber Footwear					
1939	14.8	\$22.80	37.5	\$0.61	
1954	20.7	67.43	39.9	1.69	
1955	18.2	70.70	40.9	1.75	
1956					
Jan.	26.2	74.37	40.2	1.85	
Feb.	26.1	74.74	40.4	1.85	
Mar.	25.8	71.16	39.1	1.82	
Apr.	20.3	72.25	39.7	1.82	
May	20.0	72.25	39.7	1.82	
June	19.4	70.53	39.4	1.79	
July	18.9	71.28	39.6	1.80	
Aug.	19.2	70.35	39.3	1.79	
Sept.	19.3	71.71	39.4	1.82	
Oct.	19.1	71.71	39.4	1.82	
Nov.	18.7	71.55	39.1	1.83	
Dec.	18.4	73.26	39.6	1.85	
1957					
Jan.	18.1	71.94	39.1	1.84	
Feb.	17.6	72.10	39.4	1.83	
Mar.	17.6	72.86	39.6	1.84	
Other Rubber Products					
1939	51.9	\$23.34	38.9	\$0.61	
1954	94.3	71.91	40.4	1.78	
1955	107.9	78.35	41.9	1.87	
1956					
Jan.	112.2	79.73	41.1	1.94	
Feb.	107.8	77.95	40.6	1.92	
Mar.	105.6	76.99	40.1	1.92	
Apr.	106.6	77.95	40.6	1.92	
May	104.7	76.40	40.0	1.91	
June	99.0	76.02	39.8	1.91	
July	99.1	77.78	40.3	1.93	
Aug.	101.8	78.76	40.6	1.94	
Sept.	105.2	81.18	41.0	1.98	
Oct.	109.2	82.98	41.7	1.99	
Nov.	105.4	79.98	40.6	1.97	
Dec.	109.9	82.59	41.5	1.99	
1957					
Jan.	110.1	81.60	40.8	2.00	
Feb.	108.0	81.18	41.0	1.98	
Mar.	107.0	81.39	40.9	1.99	

Sources: BLS, United States Department of Labor.

U.S.A. Rubber Use by Products

(1,000 Long Tons)

Year	Transportation			Non-Transportation			Grand Total
	Natural	Synthetic	Total	Natural	Synthetic	Total	
1955	409.6	550.3	959.9	225.2	344.6	569.8	1,529.7
1956							
1st q.	100.8	138.2	239.0	53.3	93.4	146.7	385.7
2nd q.	91.9	134.3	226.2	47.5	84.6	132.1	358.3
3rd q.	83.7	123.9	207.6	45.5	76.0	121.5	329.1
4th q.	87.6	136.5	224.1	52.8	89.4	142.2	366.3
Total	364.0	533.0	897.0	198.1	341.4	539.5	1,436.5

Sources: Secretariat of the International Rubber Study Group.

smells removed—sales improved

Custom-created odor control chemicals for any rubber product—natural, synthetic, foam. Add Alamask directly to liquid state. Call us about your problem.

RHODIA INC.

60 EAST 56TH STREET, NEW YORK 22, N.Y. (PHONE PL. 3-4850) REPRESENTATIVES IN: PHILADELPHIA • CINCINNATI • CHICAGO • DENVER • LOS ANGELES • MONTREAL • MEXICO CITY



it's Alamask[®] treated foam rubber

MOLDS

WE SPECIALIZE IN MOLDS FOR
**Heels, Soles, Slabs, Mats, Tiling
and Mechanical Goods**

MANUFACTURED FROM SELECTED HIGH
GRADE STEEL BY TRAINED CRAFTSMEN,
INSURING ACCURACY AND FINISH TO
YOUR SPECIFICATIONS. PROMPT SERVICE.

L. C. WADE CO., INC.

79 BENNETT ST.

LYNN, MASS.

THE ALUMINUM FLAKE COMPANY

AKRON 14, Ohio

Manufacturers and distributors of

ALUMINUM FLAKE

A colloidal hydrated aluminum silicate FILLER FOR
SYNTHETIC AND NATURAL RUBBER.

A. F. D. Filler

For adhesives, with Polyamides

NEW ENGLAND AGENTS:

H. A. SCHLOSSER & CO.
401 Industrial Bank Bldg.
Providence 1, R. I.

WAREHOUSE STOCKS

"ANNALS OF RUBBER"

A Chronological Record of the Important
Events in the History of Rubber

**—50c per Copy—
RUBBER WORLD**

386 Fourth Ave.

New York, 16, N. Y.

Additional Men

Assigned to Field Service

Trained personnel promptly service urgent re-
quirements in your plant. Or can visit you at
lower cost as part of scheduled trip including
other firms.

Provides "Certificate of Calibration" in com-
pliance with Government inspection require-
ments.

**SCOTT
TESTERS**

*Trademark

SCOTT TESTERS, INC.

90 Blackstone St., Providence, R. I.

STEEL CALENDER STOCK SHELLS



ALL STEEL, ALL WELDED CONSTRUCTION, with
forged steel hubs for 1¼", 1½" and 2" square bars.
4", 5", 6", 8", 10", 12", 15", 20" and 24" diameters.
Any length. Also Special Trucks (Leaf Type) Racks,
Tables and Jigs.

Used in manufacturing rubber and plastic products.

THE W. F. GAMMETER COMPANY
CADIZ, OHIO

THE NAME TO REMEMBER
FOR PRECISION



Manufacturers of the World's
Finest Rubber Curing Equipment

CLASSIFIED ADVERTISEMENTS

ALL CLASSIFIED ADVERTISING MUST BE PAID IN ADVANCE
(No agency commission allowed except on display units)

GENERAL RATES

Light face type \$1.25 per line (ten words)
Bold face type \$1.60 per line (eight words)
Allow nine words for keyed address.

SITUATIONS WANTED RATES

Light face type 40c per line (ten words)
Bold face type 55c per line (eight words)

SITUATIONS OPEN RATES

Light face type \$1.00 per line (ten words)
Bold face type \$1.40 per line (eight words)

Letter replies forwarded without charge,
but no packages or samples.

Address All Replies to New York Office at 386 Fourth Avenue, New York 16, N. Y.

SITUATIONS OPEN

RUBBER TECHNOLOGIST FOR TECHNICAL SERVICE

DUTIES involve organizing, supervising, and interpreting rubber compounding studies and presenting results to sales personnel and directly to customers.

QUALIFICATIONS should include a degree in Chemistry or Chemical Engineering and three to six years' experience in practical dry rubber compounding.

STARTING SALARY will be commensurate with qualifications and previous experience.

BENEFITS include deferred profit-sharing and liberal pension, health and life insurance plans.

Your complete resume, including salary requirements, will be treated with confidence and acknowledged promptly.

Please direct to: **Godfrey L. Cabot, Inc.**
77 Franklin Street
Boston 10, Massachusetts
Att: Employment Manager



TECHNICAL SALES—RUBBER CHEMICALS

Excellent opportunities for three qualified men in development contact work with rubber and plastics companies. Should have adequate technical knowledge to assist customers with compounding problems. Some factory experience is also desired. Territories are open in New England; Ohio and Central States; and Chicago and Midwest. Company car furnished, and many liberal benefits provided. Send complete resume including salary requirements to Mr. R. M. Simpson, Manager Piment Sales, COLUMBIA-SOUTHERN CHEMICAL CORPORATION, One Gateway Center, Pittsburgh 22, Pa.

LATEX CHEMIST

Progressive manufacturer of latex compounds interested in acquiring the services of an experienced latex chemist. Permanent position with good opportunity for advancement. Please send resume stating age, education, experience, and salary desired to Box No. 2082, care of RUBBER WORLD.

TECHNICAL DIRECTOR OR PLANT MANAGER. NEW AND modern northern Ohio precision molded plant specializing in O-Rings, Diaphragms, Seals, etc., wants experienced compounder to head compounding, production, and research. All replies confidential. Address Box No. 2083, care of RUBBER WORLD.

OPENINGS EXIST FOR CHEMICAL ENGINEERS IN OUR LABORATORY

1—Senior Engineer with 2 to 3 years' experience in mechanical molded rubber goods preferably. 1—Junior Engineer—no experience required. Openings in our Industrial Engineering Department for 1 Engineer. Desire some experience in time-study methods, estimating quality standards and tooling. Please send resume to Personnel Manager, ST. CLAIR RUBBER COMPANY, Marysville, Michigan.

DO YOU KNOW A FEMALE WRITER INTERESTED IN A GOOD job? Major supplier of chemicals to the rubber industry has opening in editorial and advertising department for a female assistant. Applicant should be conversant in the language of rubber, an accurate typist, and have good sense of design in preparing material for publication. Background should include some formal chemical education and 5 years' or more experience in the rubber industry. Salary commensurate with experience and ability. Rubber Department, R. T. VANDERBILT CO., INC., 230 Park Avenue, New York 17, N. Y.

GO SOUTH, YOUNG MAN!

Real Opportunities

1. Rubber and Plastics Chemists and Chemical Engineers, Research and Development.
 2. Calendar Room Supervisor and Compounder.
- New opportunities for your future in the New South. Write or call today
CONTINENTAL TAPES, CAYCE, S. C.

WANTED: YOUNG CHEMICAL ENGINEER WITH 5 TO 10 years' experience in compounding and production of molded mechanical rubber goods and plastics. Exceptional opportunity with company in a strong financial position, yet small enough that you will be working with top management. Location—Southwest. Give complete details as to personal history, education, experience, and salary desired in first letter. Address Box No. 2084, care of RUBBER WORLD.

SITUATIONS OPEN (Continued)

SALES REPRESENTATIVE—TECHNICALLY MINDED TO HANDLE complete line of protective and decorative coatings for rubber products. Nationally and internationally advertised. Used the world over. Address Box No. 2085, care of RUBBER WORLD.

SUPERVISOR FOR DIVISION MANUFACTURING HARD RUBBER battery covers and cases. Division uses both manual and semi-automatic presses. Must have knowledge of formulation, as well as be able to operate division, supervising 25-35 employees. Give full details, together with salary requirements, to Box No. 2086, care of RUBBER WORLD.

SUPERINTENDENT FOR NIGHT SHIFT (5 NIGHTS) RUBBER molding plant located Eastern Penna. Must have all-around experience and be able to maintain high production. If you are interested in a steady, good-paying position, with plenty of future opportunity, send complete resume, including salary expected, to Box No. 2087, care of RUBBER WORLD.

RUBBER CHEMIST, MEDIUM-SIZE PHILA. PLANT. PREFER practical man to theorist. Fully experienced with complete knowledge of compounding. Steady, good pay, and opportunity to advance. Send complete resume including salary expected. Address Box No. 2088, care of RUBBER WORLD.

CHEMIST—Polymer

Polymer Chemist for application research in peroxide catalysts. Write full details to Mr. Minich, NUODEX PRODUCTS COMPANY, Elizabeth, N. J.

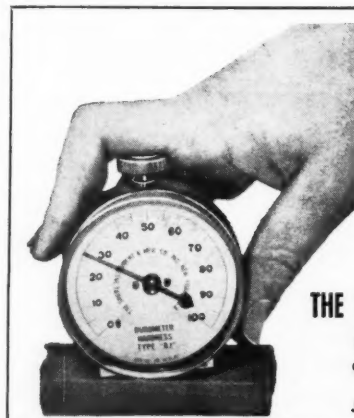
JOHN ROYAL CIRCULAR FIRE HOSE WANTED A MAN EXP. at set up and operation. Greater Boston firm will pay exceptional wages. All expenses paid for interview here. Write, wire, or call CENTRAL EMPLOYMENT, 595 Mass. Ave., Camb., Mass.

MACHINERY & SUPPLIES FOR SALE

FOR SALE—1 27" x 27" 8-OPENING HYDRAULIC PRESS 18" ram, 16" x 48" 3-roll calender, 1 8" x 12" 2-roll mill, 1 125-HP reduction unit and motor, also mills, extruders, vulcanizers, etc. CHEMICAL & PROCESS MACHINERY CORP., 52 Ninth St., Brooklyn 15, N. Y.

FOR SALE—BANBURY #9 INTERNAL RUBBER MIXER—STEL- lite tipped rotors, spray-type cooling, chrome-plated sliding door, air-operated hopper door, #4 Birmingham reducer unit. Also available for immediate delivery #3 Banbury Mixer. SHERMAN RUBBER MACHINERY COMPANY, Division of Botwinik Brothers of Mass., Inc., 22 Sherman St., Box 831, Worcester, Mass.

FOR SALE: 68" X 24" 3-ROLL CALENDER; 40" X 16" MILL; 50" x 16" Mill; 80" x 20" Mill; Scott inclined plane tensile tester. COOKE COLOR & CHEMICAL CO., Hackettstown, N. J. Garden 5-3946.



**RUBBER
HARDNESS
ORIGINAL SHORE
DUROMETER
A-2 SCALE
(A.S.T.M. D676)
VARIOUS OTHER
MODELS FOR TESTING
THE ENTIRE RANGE
TECHNICAL DATA
ON REQUEST**

**THE SHORE INSTRUMENT
& MFG. CO. INC.**
90-35 VAN WYCK
EXPRESSWAY
JAMAICA 35, N.Y.

MACHINERY & SUPPLIES FOR SALE (Con't.)

FOR SALE: ALL IN STOCK 2-40 HP SPROUT-WALDRON rotary knife cutters or rubber hogs. 3-48" x 84" vulcanizers—quick-opening doors. 6-oz. Lester, 6-oz. Watson-Stillman injection MOLDING MACHINES. Jacketed sigma-blade MIXERS—24, 5, 10, 30, 50, 60, 75, 100, 150, 300 gal. capacity, stainless steel & steel. Tablet, pellet or preform PRESSES—Stokes "R," "T," "DD-2," "RD-4," Kux rotary 21, 25 punch. 6-465 gal. stainless steel REACTORS, 150-1,650 I.W.P., 165- jacket. Send for complete inventory. PERRY EQUIPMENT CORP., 1424 N. 6th St., Phila. 22, Pa.

WHEN YOU THINK OF RUBBER MACHINERY

Think of
JOHNSON MACHINERY
Largest Stock in the U. S.

Extruders, Tablet Presses, Injection Molders, Hydraulic Presses, Scrap Cutters, Calenders, Mills, Blenders, Mixers, Ovens, Hydraulic Pumps, Laminating and Molding Equipment. See Us First. JOHNSON MACHINERY CO., 679 Frelinghuysen Ave., Dept. RW, Newark, N. J. Bigelow 8-2500.

HYDRAULIC PRESSES, 800-TON MULTI-OPENING, 26" x 38" platens. 500-ton Southwark downstroke 32" x 36". 3—300-ton upstroke, 22" x 35". 300-ton multi-opening 40" x 40" platens. 2—200-ton Farrel, 30" x 30". 200-ton 20" x 80" platens. 150-ton 24" x 24" platens. 140-ton 30" x 36" platens. 3—115-ton Dunning & Boshert, 20" x 24". 100- to 300-ton Stokes Transfer Molding Presses. New & Used Lab. 6" x 13", 6" x 16", and 8" x 16" Mills and Calenders, and sizes up to 84". Baker-Perkins & Day Heavy-Duty Jack. Mixers up to 150 gals. Hydraulic Pumps & Accumulators, Rotary Cutters. Single Punch & Rotary Pre-form Machines. Banbury Mixers, Crushers, Churns, Bale Cutters, Gas Boilers, etc. SEND FOR SPECIAL BULLETIN. WE BUY YOUR SURPLUS MACHINERY. STEIN EQUIPMENT CO., 107-8th Street, Brooklyn 15, N. Y. STerling 8-1944.

CUTTING—RUBBER—SOLES NEW WELLMAN MACHINE

UNVULCANIZED RUBBER OR PLASTIC
BEVEL OR STRAIGHT EDGE
CUT PRECISION SOLES UP TO 1" THICK

WELLMAN CO., MEDFORD, MASS., U. S. A.

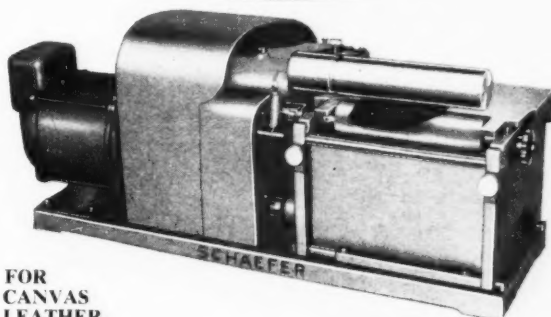
Guaranteed NEW · USED · REBUILT MACHINERY

We have for Sale No. 3 and No. 9 Banbury Mixers.

22 SHERMAN ST. • WORCESTER, MASS.



Schaefer GLUERS & CEMENTERS



FOR
CANVAS
LEATHER
GASKETS
ASBESTOS
FIBREGLAS
CARDBOARD
HARD RUBBER
FOAM RUBBER
PLASTIC FOAM
SPONGE RUBBER
DIE CUT METAL

Versatile Schaefer Cementers are practical for latex and solvent rubber cements. Bench machines for short runs and conveyor machines to cement the top side of sheets for production. 8" to 60" wide. Ideal for rubber industry.

FOR
FELT
CORK
FIBRE
PAPER
FABRIC

Schaefer MACHINE COMPANY, INC.
141 Front St. • Bridgeport 6, Conn.

HOWE MACHINERY CO., INC.
30 GREGORY AVENUE PASSAIC, N. J.

Designers and Builders of
"V" BELT MANUFACTURING EQUIPMENT
Cord Latexing, Expanding Mandrels, Automatic Cutting,
Slitting, Flipping and Roll Drive Wrapping Machines.
ENGINEERING FACILITIES FOR SPECIAL EQUIPMENT
Call or write.

NEW and REBUILT MACHINERY

Since 1891

L. ALBERT & SON

Trenton, N. J.,

Akron, Ohio,

Chicago, Ill.,

Los Angeles, Calif.

GUARANTEED REBUILT MACHINERY

IMMEDIATE DELIVERIES FROM STOCK

MILLS, CALENDERS, TUBERS
VULCANIZERS, ACCUMULATORS



HYD. PRESSES, PUMPS, MIXERS
CUTTING MACHINES, PULVERIZERS

UNITED RUBBER MACHINERY EXCHANGE

183-189 ORATON ST.

CABLE "URME"

NEWARK 4, N. J.

AKRON RUBBER MACHINERY CO., INC.

200 S. Forge St.

AKRON 9, OHIO

Phone HE 4-9141

"ARMACO"

We are one of the foremost specialists in supplying used, reconditioned, and new machinery for the Rubber and Plastic industries only. NEW—Laboratory mills, hydraulic presses, extruders, bale cutters, and vulcanizers. We are interested in purchasing your surplus machinery or complete plant.

"ARMACO"

RUBBER AND PLASTICS MACHINERY MANUFACTURING LICENSES SOUGHT FOR ENGLAND

Old-established substantial British manufacturer seeks

- (1) Modern-type Tire Molding Presses.
- (2) Crossed-axis or roll-Bending Device for gauge control, for manufacture and sale outside Dollar area.
- (3) Internal Mixers for Plastics and Rubber.
- (4) Plastic Extruders.

ADDRESS BOX No. 2081, c o RUBBER WORLD

MANUFACTURING BUSINESS WANTED

We are now manufacturing over \$20,000,000 in various lines and wish to expand by acquisition of assets or stock of one or more industrial companies. In our negotiations the sellers' problems and wishes will receive full consideration. Present personnel will normally be retained. Address all replies "confidentially" C. J. GALE, Sec., P. O. Box 1351, Church St. Station, New York 8, N. Y.

MIXING

To Your Specification

K. B. C. INDUSTRIES, INC. NEW HAVEN, CONN.

881 State Street Tel: State 7-5662
Otto J. Lang, General Manager

SINCE 1880

RUBBER & PLASTIC

Rand.
REG. U. S. PAT. OFF.

"They Last Longer"
REG. U. S. PAT. OFF.
DRESS SHIELDS RUBBER APRONS
DRESS SHIELD LININGS STOCKINET SHEETS
BABY PANTS RUBBER SHEETS
BABY BIBS & APRONS RAINCAPES & COATS
SANITARY WEAR RUBBER SPECIALTIES
RUBBERIZED SHEETING VINYL PLASTIC
RUBBER DAM & BANDAGES — SHEET GUM

RAND RUBBER CO. BROOKLYN, N. Y. U. S. A. MFRS.

Custom Mixing

RUBBER - PLASTICS

We do milling and compounding of all types—black or color—master batches

All mixing done under careful supervision and laboratory control.

Phone: Butler 9-0400

Peguanoc Rubber Co.

MAIN OFFICE: BUTLER, N. J.
FACTORIES: BUTLER, N. J. and TALLAPOOSA, GA.



CONSULTANTS & ENGINEERS

GIDLEY LABORATORIES, INC.

PHILIP TUCKER GIDLEY — "RESEARCH IN RUBBER"

Consulting engineering, formulas, product development, chemical and physical tests and factory surveys

Fairhaven

Massachusetts

HALE & KULLGREN, INC.

Specialists in Processes and Plants for Rubber and Plastics

A Complete Engineering Service
Including: Economic Surveys; Process Design;
Installation; Contracting and Operation.

613 E. Tallmadge Ave., Akron 10, Ohio

THE JAMES F. MUMPER CO., ENGINEERS

Complete engineering for Rubber & Plastics plants. Plant location, Production & Economic surveys. Equipment layout, Special equipment design, Buildings, material handling & service facilities. New plants, Additions, Alterations & Improvements. Procurement & Inspection service.

39 East Market Street

Akron 8, Ohio

Where the Compounding and Engineering Problems of the Manufacturer may be solved.



INDUSTRIAL RUBBER GOODS

BLOWN—SOLID—SPONGE

FROM NATURAL, RECLAIMED, AND SYNTHETIC RUBBER

THE BARR RUBBER PRODUCTS CO., SANDUSKY, OHIO

SWEDISH RUBBER HANDBOOK

2nd Edition

This new issue gives systematic classification of more than 2,000 chemicals and other raw materials, as well as machinery for the Rubber Industry. Every product has a short description, and the name and address of the supplier of everyone is given.

More than 200 suppliers all over the world are included, which makes the Handbook most useful for prospective purchasers.

Also included are worthwhile tables and other information for Rubber Technicians and Subject Index for Raw Materials and Machinery.

Printed in English and Swedish, 224 pages.

Price \$8.00 per copy, postpaid.

(In N.Y.C. add 3% sales tax)

PUBLISHED BY:

THE SWEDISH INSTITUTION OF
RUBBER TECHNOLOGY, STOCKHOLM

DISTRIBUTED BY:

RUBBER WORLD

386 Fourth Avenue

New York 16, N. Y., U.S.A.

Index to Advertisers

This index is maintained for the convenience of our readers. It is not part of the advertisers' contract, and RUBBER WORLD assumes no responsibility to advertisers for its correctness.

A	
Adamson United Co.	655
Aetna-Standard Engineering Co.	—
Akron Rubber Machinery Co., Inc., The	761
Albert, L. & Son	761
Alco Oil & Chemical Corp.	632
Aluminum Flake Co.	759
American Cyanamid Co., Rubber Chemicals Dept.	747
American Synthetic Rubber Corp.	—
American Zinc Sales Co.	Third Cover
Ames, B. C., Co.	740
Amoco Chemicals Corp.	—

B	
Barco Manufacturing Co.	—
Barr Rubber Products Co., The	762
Black Rock Mfg. Co.	—
Bolling, Stewart, & Co., Inc.	—
Borden Co., The Chemical Division	—
Brockton Tool Co.	—
Brooklyn Color Works, Inc.	740

C	
Cabot, Godfrey L., Inc.	Back Cover
Carter Bell Mfg. Co., The	666
Cary Chemicals, Inc.	—
Celanese Corp. of America	740
Cellusuede Products, Inc.	664
Claremont Waste Mfg. Co.	760-762
CLASSIFIED ADVERTISEMENTS	760-762
Cleveland Liner & Mfg. Co., The	656
Columbia-Southern Chemical Corp.	728
Columbian Carbon Co.	Insert 709, 710
Mapico Color Unit	—
CONSULTANTS & ENGINEERS	762
Continental Carbon Co.	741
Continental Machinery Co., Inc.	755
Copolymer Rubber & Chemical Corp.	649
Cylinder Manufacturing Co.	—

D	
Darlington Chemicals, Inc.	670
Dayton Rubber Co., The	738
Diamond Alkali Co.	—
Dow Chemical Co., The	—
Dow Corning Corp.	751
DPR Incorporated, A Subsidiary of H. V. Hardman Co.	757
du Pont de Nemours, E. I., & Co.	Second Cover, 668, 669
Durez Plastics Division, Hooker Electrochemical Co.	—

E	
Eagle-Picher Co., The	738
English Mica Co., The	—
Enjay Co., The	739
Erie Engine & Mfg. Co.	670
Erie Foundry Co.	665

F	
Falls Engineering & Machine Co., The	—
Farrel-Birmingham Co., Inc.	—
Ferry Machine Co.	757
Firestone Tire & Rubber Co., The (Synthetic Rubber & Latex Division)	657
Flexo Supply Co., The	—
French Oil Mill Machinery Co., The	626

G	
Gale, C. J.	762
Gammeter, W. F., Co., The	759
General Magnesite & Magnesite Co.	—
General Tire & Rubber Co., The (Chemical Division)	652, 653

Genseke Brothers	641
Gidley Laboratories, Inc.	762
Glidden Co., The (Chemicals, Pigments, Metals Division)	—
Goodrich, B. F., Chemical Co.	623
Goodrich-Gulf Chemicals, Inc.	624
Goodyear Tire & Rubber Co., Inc., The (Chemical Division)	Insert 629-630; 631

H	
Hale & Kullgren, Inc.	762
Hall, C. P., Co., The	644
Harchem Division, Wallace & Tiernan, Inc.	—
Harwick Standard Chemical Co.	663
Hercules Powder Co.	—
Hoggson & Pettis Mfg. Co., The	—
Holliston Mills, Inc., The	—
Holmes, Stanley H., Co.	—
Howe Machinery Co., Inc.	761
Huber, J. M., Corp.	672

I	
Iddon Brothers, Ltd.	662
Independent Die & Supply Co.	—
Industrial Ovens, Inc.	737
Institution of the Rubber Industry	666

J	
Jefferson Chemical Co., Inc.	—
Johnson Corp., The	755

K	
K. B. C. Industries, Inc.	762

L	
Lambert, E. P., Co.	662
Liquid Carbonic Corp.	—
Litzler, C. A., Co., Inc.	658

M	
Mapico Color Unit, Columbian Carbon Co.	—
Marbon Chemical Division of Borg-Warner Corp.	650
Master Development Co., Inc.	734
McNeil Machine & Engineering Co., The	759
Merck & Co., Inc., Marine Magnesium Division	—
Monsanto Chemical Co.	642
Morris, T. W., Trimming Machines	—
Muehlstein, H., & Co., Inc.	637
Mumper, James F., Co., The	762

N	
National Aniline Division, Allied Chemical & Dye Corp.	671
National Chemical & Plastics Co., The	670
National Rubber Machinery Co.	—
National Standard Co.	661
Naugatuck Chemical Division of U. S. Rubber Co.	625, 635
Neville Chemical Co.	636
New Jersey Zinc Co., The	627
Nopco Chemical Co.	—

O	
Oakite Products, Inc.	670
Osborn Manufacturing Co., The	—

P	
Pennsalt Chemicals Corp., Industrial Division	727

Pennsylvania Industrial Chemical Corp.	—
Pequanoc Rubber Co.	762
Phillips Chemical Co.	622, 745
Polymer Corp., Ltd.	733
Pure Carbonic Co.	755

R	
Rand Rubber Co.	762
Rare Metal Products Co.	—
Rhodia, Inc.	759
Richardson, Sid. Carbon Co.	764
Ross, Charles, & Son Co., Inc.	736
Royle, John, & Sons	664
Rubber Corp. of America	755
Rubber Regenerating Co., Ltd., The	743

S	
St. Joseph Lead Co.	638
Sargent, C. G., Sons Corp.	—
Schaefer Machine Co., Inc.	761
Schlosser, H. A., & Co.	759
Scott Testers, Inc.	759
Scovill Manufacturing Co.	645
Shaw, Francis, & Co., Ltd.	—
Shell Chemical Corp., Synthetic Rubber Sales Division	667
Shell Oil Co.	659
Sherman Rubber Machinery Co.	761
Shore Instrument & Manufacturing Co., Inc., The	760
Silicones Division, Union Carbide Corp.	—
Sinclair-Collins Valve Co., The	634
South Texas Tire Test Fleet, Inc.	—
Southeastern Clay Co.	—
Southern Clays, Inc.	628
Spadone Machine Co., Inc.	—
Stamford Rubber Supply Co., The	753
Sun Oil Co.	735

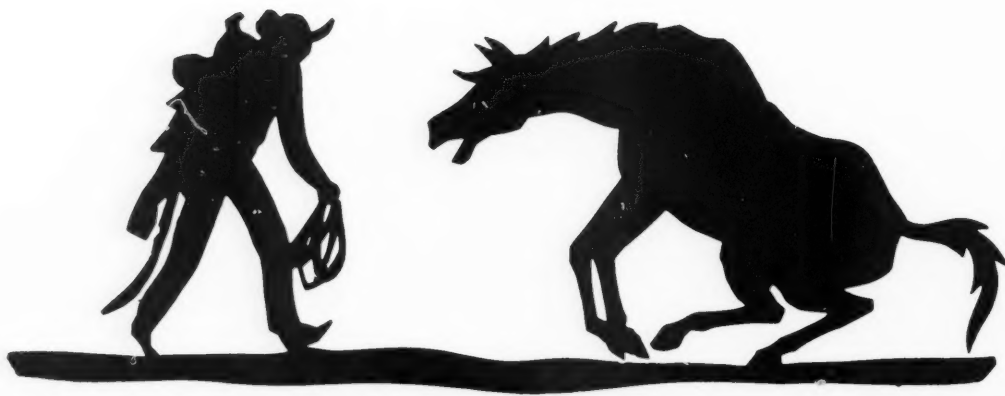
T	
Taylor Instrument Cos.	—
Taylor, Stiles & Co.	753
Texas-U. S. Chemical Co.	643
Thiokol Chemical Corp.	646, 647
Thomaston Mills	757
Timken Roller Bearing Co., The	—
Titanium Pigment Corp.	648
Torrington Co., The	—
Turner Halsey Co.	—

U	
Union Carbide Chemicals Co., Division of Union Carbide Corp.	654
Union Carbide Corp.	—
Union Carbide Corp., Silicones Division	—
Union Carbide Chemicals Division	654
United Carbon Co., Inc.	Insert 639, 640
United Engineering & Foundry Co.	651
United Rubber Machinery Exchange	761
Universal Oil Products Co.	—

V	
Vanderbilt, R. T., Co., Inc.	674
Velsicol Chemical Corp.	633

W	
Wade, L. C., Co., Inc.	759
Wellington Sears Co.	749
Wellman Co.	761
Western Supplies Co.	757
White, J. J., Products Co.	658
Whittaker, Clark & Daniels, Inc.	—
Williams, C. K., & Co., Inc.	—
Witco Chemical Co.	741
Woloch, George, Co., Inc.	664
Wood, R. D., Co.	660

X	
Xylos Rubber Co.	—



Paul L. May

...sagging

Quality of product usually sags when substitutions are made for channel black. Alternate materials are always lacking in some important quality. When used alone or in blends channel black gives many extra advantages.

TEXAS "E" or TEXAS "M" used in blends with fast curing furnace blacks give you an economical way to retard scorch. These blends also improve tensile, elongation, tear, and heat build-up for better all-around product performance.

TEXAS
CHANNEL BLACKS

Sid Richardson
C A R B O N C O.

FORT WORTH, TEXAS

GENERAL SALES OFFICES
EVANS BUILDING
AKRON 8, OHIO

AZODOX

TRADE MARK

New, Higher Density Zinc Oxide

INCREASES MIXING CAPACITY
... SPEEDS PRODUCTION



HERE ARE OTHER REASONS WHY AZODOX IS BEST FOR YOU

Twice the Density, Half the Bulk. Cuts storage space in half. Despite high density, perfect texture of material is unchanged. AZODOX package is shaped, permitting close-packed, well-formed unitized shipments.

Flows More Freely, Less Dusting than conventional zinc oxides.

Physical Properties Unchanged Except for Density. Surface area, size and shape, color and all other physical properties of AZO-ZZZ, American Process, zinc oxides are unaltered. *Apparent density only is changed.* All chemical properties are unchanged.

AZODOX Cuts Your Costs. Faster handling, easier storing, quicker mixing save you money.

AZODOX now ready for you in unlimited quantities. Priced the same as conventional zinc oxides. Available in surface treated form if desired.

Tests prove AZODOX, new form of zinc oxide (de-aerated), to be superior in all mixing operations. AZODOX incorporates readily, disperses completely in both hard and soft stocks, at high or low concentrations, on the mill or in the Banbury. Hard crust, common to pellets, is never present to cause dispersion problems. *Unlike pellets AZODOX does not consist of agglomerates.*

AZODOX is available in all grades of American process lead-free zinc oxide.

American
Zinc sales company

Distributors for

AMERICAN ZINC, LEAD & SMELTING COMPANY
COLUMBUS, OHIO • CHICAGO • ST. LOUIS • NEW YORK

CABOT
VULCAN

REINFORCING CARBON BLACKS

3-6-9

for BEST HIGH-SPEED TIRE MILEAGE



GODFREY L. CABOT, INC. 77 FRANKLIN ST., BOSTON 10,

